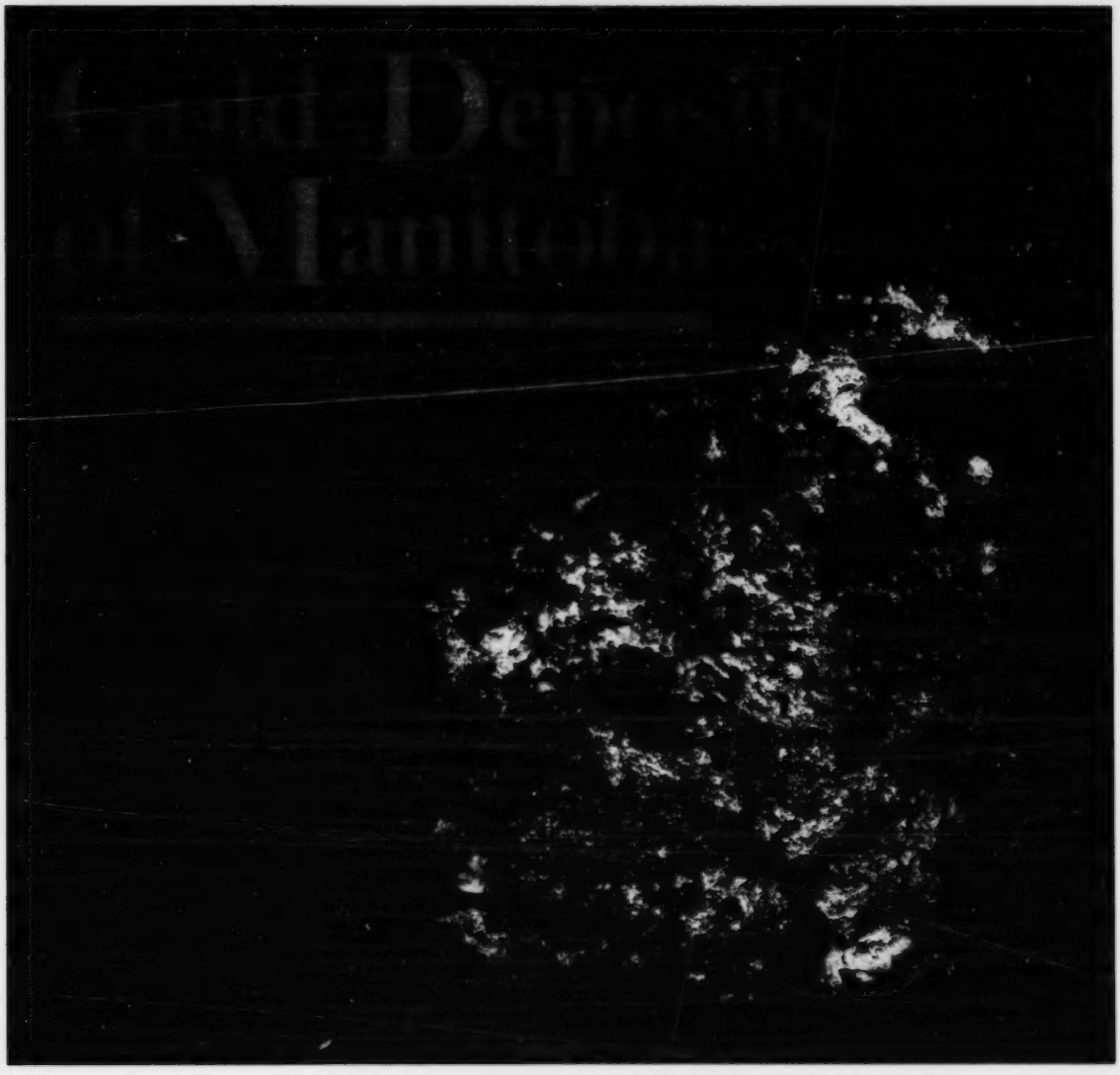
MINERALS

ECONOMIC & REGIONAL DEVELOPMENT AGREEMENT

MANITOBA ENERGY AND MINES



Canada

Manitoba

88-01895/

ERRATA: Gold Deposits of Manitoba (ER86-1)

1) Due to a typesetting problem, all ± symbols were omitted from the final print of the text; these include both age dates (e.g. 2650 ± 80 Ma, p. 36) and minerals (e.g., Table 6, p. 79: ± magnetite; ± amphibole), etc.

2) p. 36, 3rd last para., l. 4: 'Island Lake' should read 'Cross Lake'.

3) p.76, line 3:'more than' should read 'up to'.

Manitoba
Energy and Mines
Minerals Division

Economic Geology Report ER86-1

Gold Deposits of Manitoba

By D.J. Richardson and G. Ostry

Winnipeg, 1987

Energy and Mines

Hon. Wilson D. Parasiuk
Minister

Charles S. Kang
Deputy Minister

Minerals Division
Sobharam Singh
Assistant Deputy Minister

A CONTRIBUTION TO PROGRAMMING CONDUCTED UNDER THE
CANADA-MANITOBA MINERAL DEVELOPMENT SUBSIDIARY AGREEMENT,
PART OF THE ECONOMIC AND REGIONAL DEVELOPMENT AGREEMENT

Front cover: High grade gold specimen from the San Antonio Mine, Bissett, Manitoba. It measures 24x20x5 cm and contains an estimated 5.41 kg (174 troy oz.) gold (photograph courtesy of the National Museum of Natural Sciences, Ottawa).

TABLE OF CONTENTS

Page

INTRODUCTION 1
Manitoba Gold Production 1
Gold Exploration and Production: 1890-1979 3
Gold Exploration and Production: 1980-1986 3
Acknowledgements 5

REGIONAL GEOLOGY OF MANITOBA 7
Superior Province 7
Churchill Province 7
Churchill-Superior Boundary Zone 7

WEST HAWK LAKE-FALCON LAKE-SHOAL LAKE AREA 9
Regional Geology 9
Structure 9
Mineralization 9
Past Producers 9

RICE LAKE GREENSTONE BELT 15
Regional Geology 15
Metamorphism. 16
Structure 16
Mineralization 16
Past Producers 18
Deposits 29

STEVENSON LAKE-BIGSTONE LAKE-ISLAND LAKE GREENSTONE BELTS 31
Regional Geology 31
Structure 32
Mineralization 32
Past Producer 32
Gold Deposit 35

OXFORD LAKE-KNEE LAKE-GODS LAKE-KISTIGAN LAKE GREENSTONE BELTS 36
Regional Geology 36
Metamorphism 36
Structure 36
Mineralization 37
Past Producers 37
Deposit 37

CROSS LAKE-PIPESTONE LAKE-ECHIMAMISH RIVER AREA 41
Regional Geology 41
Mineralization 41

CHURCHILL-SUPERIOR BOUNDARY ZONE 42
Regional Geology 42
Mineralization 42

FLIN FLON-SNOW LAKE GREENSTONE BELT 43
Regional Geology 43
Metamorphism 44
Structure 44
Mineralization 44
Past Producers 47
Deposits 53

Page

LYNN LAKE GREENSTONE BELT 59
Regional Geology 59
Metamorphism 60
Structure 60
Mineralization 60
Present Producer 61
Deposits 67

KISSEYNEW GNEISS BELT 71
Regional Geology 71
Metamorphism 73
Structure 73
Mineralization 73
Deposits 75

SEAL RIVER AREA 79
Regional Geology 79
Metamorphism 79
Structure 81
Mineralization 81

REFERENCES 82

INDEX TO DEPOSITS 91

FIGURES

Figure 1 Location map of the major primary gold producers of Manitoba vi
Figure 2 Primary gold production in Manitoba: 1917-1986 2
Figure 3 Location map: major gold exploration projects 1980-1986 4
Figure 4 Major geological subdivisions of Manitoba 6
Figure 5 Principal geological domains of Manitoba 8
Figure 6 Geology of the West Hawk Lake-Falcon Lake-Shoal Lake area 10
Figure 7 Interpretation of the emplacement history of the Falcon Lake Igneous Complex 11
Figure 8 Geology of the Sunbeam breccia pipe 12
Figure 9 Composite level plan of the San Antonio Mine showing an outline of the 16 and 38 type veins ..... in pocket
Figure 10 Geological map of the Rice Lake area showing the location of the SAM unit 18
Figure 11 Schematic cross-section of the San Antonio mine 19
Figure 12 A schematic diagram showing the extensional zones linking en echelon shear zones 20
Figure 13 Aerial view of the San Antonio Mine 20
Figure 14 Geology in the area of the Kitchener, Hope, Rogers and Tene mines 22
Figure 15 Geology of the Gunnar mine area 23
Figure 16 Gunnar Mine site 24
Figure 17 Approximate location of the Hayes River Group-Island Lake Group interface 32
Figure 18 Gold mineralization at the eastern end of Island Lake 33
Figure 19 Geology in the area of the Island Lake Mine 34
Figure 20 Aerial view of the Island Lake Mine 34
Figure 21 Geology in the area of the Gods Lake Gold Mine 38
Figure 22 Longitudinal section of the underground workings of the Gods Lake Mine 38
Figure 23 Aerial view of the Gods Lake Mine site 39
Figure 24 Geology in the area of the Scott No. 1 occurrence 40
Figure 25 General geology of the area east of Wekusko Lake 45
Figure 26 General geology of the Snow Lake area 46
Figure 27 Longitudinal section of the Nor-Acme Mine showing HBED deep drilling intersections 48
Figure 28 Aerial view of the Nor-Acme Mine site 49
Figure 29 Laguna Mine site 50
Figure 30 General geology of the Tartan Lake area 54
Figure 31 Schematic section showing the development program and ore zones of the Tartan Lake deposit 55
Figure 32 Aerial view of the Tartan Lake property 56

Page

Figure 33 Geological subprovinces of the Churchill Structural Province and adjacent Superior Province 58
Figure 34 Airborne Input and gradiometric signature of the Agassiz Metallotect 60
Figure 35 Generalized geology of the Southern Belt and location of gold occurrences along the Johnson Shear Zone 62
Figure 36 Schematic section of layering of the MacLellan Mine host rocks and the overlying and underlying rock sequences 63
Figure 37 Mineralized zones of the MacLellan Mine 64
Figure 38 MacLellan Mine site 65
Figure 39 Cross section showing the Wendy zone at Farley Lake 66
Figure 40 Manitoba Mineral Resources Ltd. geologists examining drill core at Farley Lake 67
Figure 41 Geology in the area of the Lasthope deposit 68
Figure 42 Major tectonic domains and lithostructural units of the Churchill Province in northwest Manitoba and Saskatchewan 71
Figure 43 Geology of the Puffy Lake-Nokomis Lake area 74
Figure 44 Aerial view of Pioneer Metals Corp.'s Puffy Lake property 75
Figure 45 Schematic section showing the stratigraphic position of gold mineralization at Squall Lake 76
Figure 46 Geology of the Seal River area 80

TABLES

Table 1 Summary of primary gold producers in Manitoba 1
Table 2 General stratigraphy of the Rice Lake greenstone belt 15
Table 3 General stratigraphy of the Stevenson Lake-Island Lake-Bigstone Lake greenstone belts 31
Table 4 General stratigraphy of the Oxford Lake-Knee Lake-Gods Lake-Kistigan Lake greenstone belts 36
Table 5 General stratigraphy of the Cross Lake area 41
Table 6 General stratigraphy of the Seal River area 79

MAPS

ER86-1-1 Gold deposits and selected occurrences of the Rice Lake greenstone belt ..... in pocket
ER86-1-2 Regional geology and gold occurrences in the northern part of the Superior Province of Manitoba ..... in pocket
ER86-1-3 Geology and gold deposits of the Flin Flon greenstone belt and the southern portion of the Kisseynew sedimentary gneiss belt ..... in pocket
ER86-1-4 Bedrock geology of Granville Lake NTS 64 C ..... in pocket

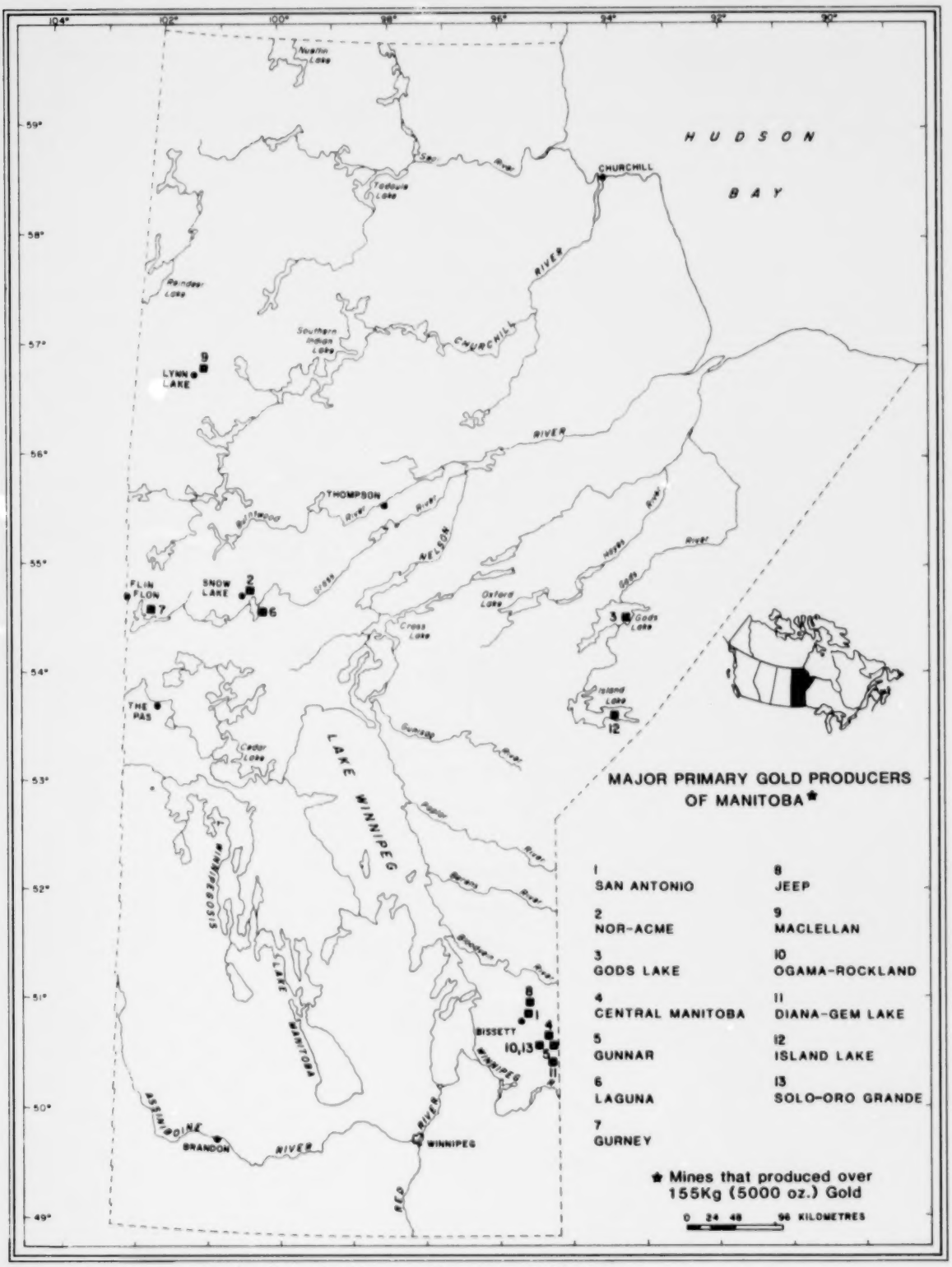


Figure 1. Location map showing the major primary gold producers in Manitoba.

INTRODUCTION

This report is a compilation of data on the primary gold deposits of Manitoba and was written in response to the resurgence of gold exploration in the province in recent years. It is intended to assist prospectors and mining companies in exploring Manitoba and provide a source of information for use in promoting the province's gold potential. The information was compiled from a variety of sources including: Manitoba Energy and Mines publications and files, Geological Survey of Canada publications, company annual reports, press clippings and personal communication with prospectors and geologists. Throughout this publication areas of primary gold mineralization are referred to as either deposits i.e., former and present producing mines and those gold occurrences with published reserve figures, or simply as occurrences i.e., localities where gold has been reported. The onerous task of describing every gold occurrence known to us in the province is beyond our present mandate; however, we have attempted to describe all gold deposits in some detail and publish the locations of all deposits and occurrences. In providing a description/synthesis of the gold mineralization in any particular area we have, ad hoc, included a description of, or data on, gold occurrences where we felt it was required and reliable information was available.

MANITOBA GOLD PRODUCTION

Manitoba's total gold production up to the end of 1986 was 160 892 kg (5 172 885 oz.) of which 51% or 82 553 kg (2 654 186 oz.) was derived as a by-product of base metal mining and 78 339 kg (2 518 699 oz.) was produced from primary gold deposits (Manitoba Energy and Mines, Mineral Policy)[1]. This report will discuss only primary gold deposits.

A total of 27 mines produced gold in Manitoba between 1917 and 1968. The majority of production, however, came from seven mines: San Antonio, Nor-Acme, Central Manitoba, Gods Lake, Gunnar, Laguna and Ogama-Rockland *(Fig. 1)*. Each of these mines produced over 1244 kg (40 000 oz.) gold and in total contributed 95% of the province's gold production *(Table 1)*. The San Antonio Mine, in southeast Manitoba, alone produced 42 000 kg (1 350 335 oz.) gold or 54% of the total production (San Antonio Gold Mines Limited, production cards 1932 to

[1]The total gold production figure includes 280 kg (9000 oz.) produced at the MacLellan Mine from August 25 to November 30, 1986 and an estimate of 2177 kg (70 000 oz.) by-product gold production for 1986.

TABLE 1
PRODUCTION FROM MANITOBA GOLD MINES*

Mine	Gold Produced kilograms (oz.)	Average Grade gold g/tonne (oz/ton)	Years in Production	Map Ref in Report
San Antonio	42 000 (1 350 335)	9.2 (0.27)	1932-1968 1982-1983	Map ER86-1-1 location RL1
Nor-Acme	19 179 (616 615)	3.9 (0.11)	1949-1958	Map ER86-1-3 location FF1
Gods Lake	4 990.5 (160 451)	10.27 (0.30)	1935-1943	Map ER86-1-2 location GL1
Central Manitoba	4 287 (137 817)	12.0 (0.35)	1928-1938	Map ER86-1-1 location RL2
Gunnar Gold	3 101 (99 713)	11.9 (0.35)	1936-1941	Map ER86-1-1 location RL3
Laguna	1 834 (58 962)	16.7 (0.49)	1936-1940	Map ER86-1-3 location FF2
Gurney	872 (28 045)	9.2 (0.27)	1937-1939	Map ER86-1-3 location FF3
Jeep	430 (13 811)	26.1 (0.76)	1947-1950	Map ER86-1-1 location RL5
Ogama-Rockland	1 410 (45 343)	11.2 (0.33)	1942 1948-1951	Map ER86-1-1 location RL4
MacLellan	280 (9 000)		1986-	Map ER86-1-4 location 1
Diana (Gem Lake)	236 (7 575)	11.4 (0.33)	1928-1932 1934-1936	Map ER86-1-1 location RL6
Island Lake	186 (5 987)	20.92 (0.61)	1934-1935	Map ER86-1-2 location IL1
Solo-Oro Grande	160.7 (5 166)	11.2 (0.33)	1932-1934	Map ER86-1-1 location RL10

*Mines that produced over 155 kg (5000 oz.) gold

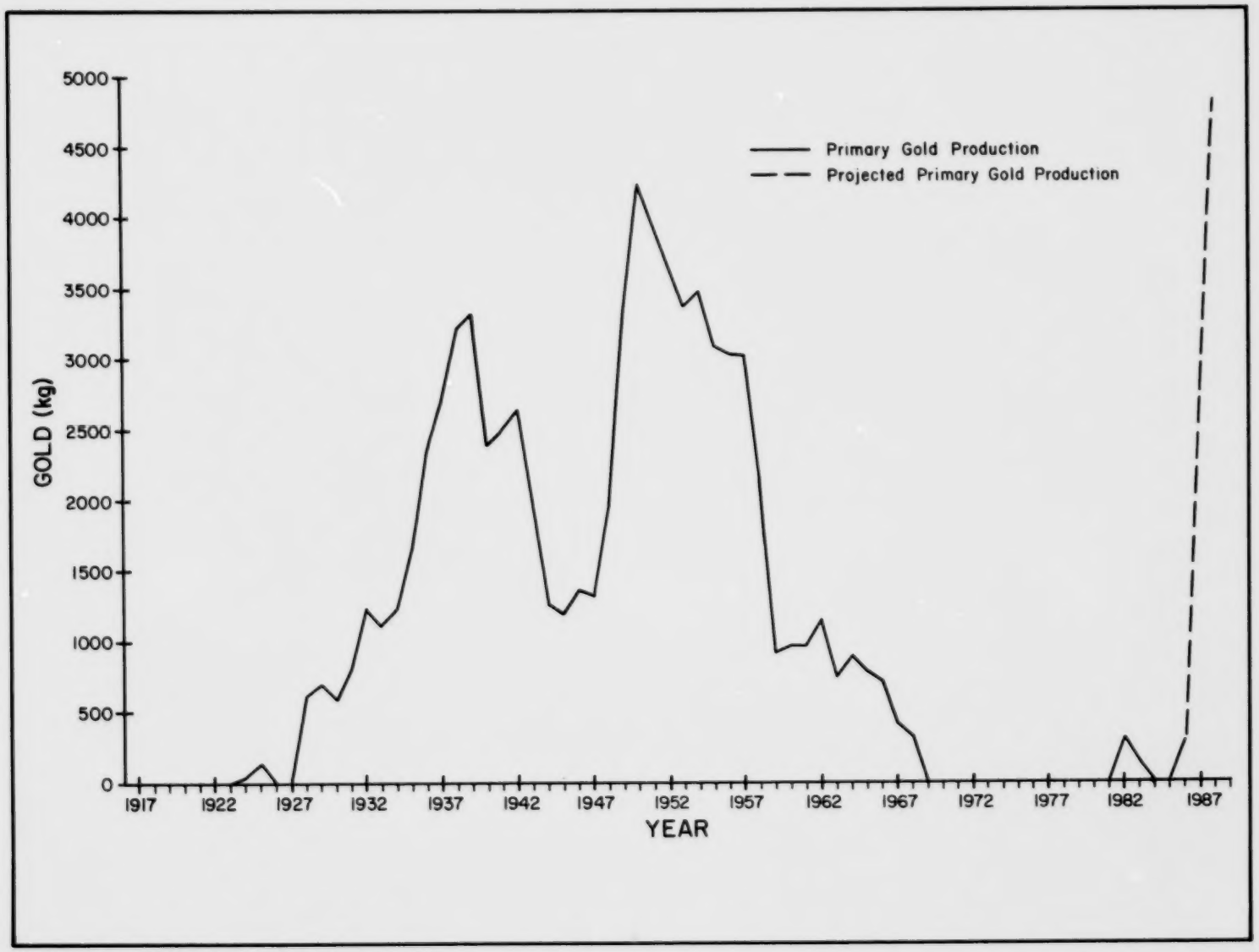


Figure 2. Primary gold production in Manitoba: 1917–1986.

1968; Manitoba Energy and Mines, Mineral Policy, production figures 1982-1983). The Nor-Acme Mine, at Snow Lake, produced 19 547 kg (628 461 oz.) of gold or 24% of the total gold production (Manitoba Mines Branch, Annual Reports 1949-1958). Manitoba's annual gold production peaked in 1950 at 4262 kg (137 020 oz.) and declined rapidly until 1968 when, with the closing of the San Antonio Mine, primary gold production in the province stopped *(Fig. 2)*. In 1986 Manitoba again became a primary gold producer with the opening of SherrGold Inc.'s MacLellan Mine near Lynn Lake. In 1987 two new deposits, Tartan Lake and Puffy Lake, will commence production and should boost Manitoba gold production in 1988 to a record high of 4820 kg (155 000 oz.) annually.

GOLD EXPLORATION AND PRODUCTION IN MANITOBA: 1890-1979

After the gold discoveries in the Black Hills of South Dakota in 1874 and in the Lake of the Woods area of Ontario in 1890, small areas of southeastern Manitoba were prospected. Manitoba's first gold occurrence was discovered there in 1890 when Tom Moore staked the Moore claim 3 km north of Falcon Lake. The significance of the Canadian Precambrian Shield, however, was not fully recognized until after the great gold discovery at Porcupine, Ontario in 1909. Many prospectors and investors then focused their attention on northwestern Ontario and Manitoba in search of the next "Porcupine camp".

In southeast Manitoba the Moore property was developed during the period 1911 to 1915 by Penniac Reef Gold Mines, Limited and produced approximately 3.1 kg (100 oz.) gold. This discovery, similar to those in the Lake of the Woods area of Ontario, proved to be of minor importance and prospectors soon moved on to other areas that were reported by officers of the Geological Survey of Canada to be favourable prospecting ground.

In the Bissett area, 160 km northeast of Winnipeg, the Gabrielle and San Antonio claims were staked in 1911 over a prospect that later became the San Antonio Mine. These claims initially received little attention in comparison to claims southeast and southwest of Bissett. The Gold Pan, Elora and Onondaga claims produced minor amounts of gold between 1919 and 1924. In 1928 Central Manitoba Mines, Limited became the first major producer of the Bissett area when the Kitchener Mine went into production. It produced a total of 4821 kg (154 988 oz.) gold from 1928 to 1938 (Central Manitoba Mines, Limited, Annual Reports, 1928-1938)[1]. At about the same time as the development of the Kitchener Mine, San Antonio Gold Mines Limited was formed to develop the San Antonio claim. The San Antonio Mine was in production from 1932 to 1968 (briefly from 1982 to mid-1983) and produced 42 000 kg (1 350 335 oz.) gold. Other gold producers of the area in decreasing order of importance were: Gunnar, Ogama-Rockland, Jeep, Diana, Poundmaker, Cryderman, Solo-Oro Grande and Grand Central.

The northwestern part of the province, though prospected in the late 1890s, was not systematically searched until after 1907. In 1914 gold was discovered 20 km southeast of Snow Lake on the east shore of Wekusko Lake (Herb Lake). In 1917 a shipment of ore from the Moose Horn claim produced 3.36 kg (108 oz.) gold (Alcock, 1917). In 1918 the Rex claim (Laguna Mine) went into production. It was in production intermittently until 1939 and produced 1833.9 kg (58 962 oz.) of gold (Manitoba Mines Branch, Annual Reports 1928-1940). In 1925 C. R. Parres staked the Toots and Chums claims in the Snow Lake area over a deposit that later became the Nor-Acme Mine and produced 19 179 kg (616 615 oz.) gold from 1949 to 1958. The Gurney Mine located 44 km east of Flin Flon was staked in 1919 and produced 872 kg (28 045 oz.) gold from 1937 to 1939. Other gold producers in the Flin Flon-Snow Lake area in decreasing order of importance were: Ferro-Rainbow, Bingo, Gold Hill and Century.

[1]The production figure of 4821 kg includes production from the Kitchener, Growler, Tene, Rogers and Hope claims.

The more remote areas of northeastern Manitoba were not explored until the late 1920s. In 1928 several gold occurrences were discovered at Island Lake. Island Lake Gold Mines, Limited produced 186 kg (5987 oz.) gold from 1934 to 1935 from an island in the east central part of the lake (Manitoba Energy and Mines, Mines Branch, Corporation Files). Farther to the northeast R.J. Jowsey and A. MacDonald discovered gold in 1932 at Gods Lake. Diamond drilling on Elk Island discovered a deposit that God's Lake Gold Mines Limited developed to produce 4991 kg (160 451 oz.) gold from 1935 to 1943 (God's Lake Gold Mines Limited, Annual Reports, 1935-1943).

In the Lynn Lake area there is little record of exploration work prior to 1930. The first gold discovery was made in 1934 by S. Akers and W. Hanson at Cartwright Lake, 23 km southeast of Lynn Lake. Subsequent discoveries were made in the Lasthope Lake-McVeigh Lake area. In 1939 drilling by Sherritt Gordon Mines, Limited at Lasthope Lake outlined a deposit of 127 000 tonnes grading 7.9 g/tonne (0.23 oz/ton) gold (Milligan, 1960). There was little gold exploration carried out in the late 1940s and early 1950s due to the emphasis on base metal exploration. In 1955 drilling carried out by Agassiz Mines Limited discovered significant gold mineralization 6.5 km northeast of Lynn Lake. The property was explored by several companies between 1950 and 1979. Diamond drilling and underground development outlined a deposit, named the Agassiz deposit, with probable and possible reserves of 1 765 000 tonnes (1 946 000 tons) averaging 8.57 g/tonne (0.25 oz/ton) gold (Royal Agassiz Mines Ltd., Annual Report, 1973).

GOLD EXPLORATION IN MANITOBA: 1980-1986

In the early 1980s gold exploration in the province remained at low levels. The only major project was the re-opening of the San Antonio Mine from January 1982 to May 1983. Expenditures on exploration increased 86% to $30.8 million in 1984 with the renewed interest in Manitoba's gold potential and the use of flow-through shares for financing. In 1985 the number of gold exploration projects in the province increased 70% from 61 to 105. As a result of this increased exploration the province now has: a new primary gold producer, SherrGold Inc.'s MacLellan Mine (formerly the Agassiz deposit); two deposits, Tartan Lake and Puffy Lake, that will start production in 1987; and several deposits in advanced stages of exploration *(Fig. 3)*.

From 1980 to 1986 Sherritt Gordon Mines Limited carried out diamond drilling and underground development on the Agassiz property. They estimated the deposit to contain mineable reserves of 1.49 million tonnes grading 7.17 g/tonne (0.21 oz/ton) gold and formed SherrGold Inc. to develop the deposit, which they renamed the MacLellan Mine (SherrGold Inc., Preliminary Prospectus, September 17, 1986). The mine commenced production in mid-1986 and poured its first bar of dore bullion on August 25, 1986. The mine, when in full production, will produce 2000 kg (65 000 oz.) of gold annually (News release to the Northern Miner, SherrGold Inc., January 1987).

In 1985 Granges Exploration Ltd. and Aberford Resources Ltd. (Abermin Corporation) discovered the Tartan Lake deposit, 14 km northeast of Flin Flon. They estimated the Main zone to contain reserves of 464 000 tonnes grading 11.97 g/tonne (0.349 oz/ton) gold (Granges Exploration Ltd., Annual Report, 1985). An underground development program, which started in 1986 and is continuing in 1987, consisted of: driving an underground decline, underground drilling and crosscutting to the ore zones. Based on the results of drilling, the joint venture partners proceeded with mill construction. They estimated that the mill may be in production by March 1987 and when in full production could produce 1556 kg (50 000 oz.) of gold annually (Northern Miner, January 12, 26, 1987).

In 1985 Maverick Mountain Resources Limited announced the discovery of the Puffy Lake deposit, 63 km northeast of Flin Flon (Maverick Mountain merged with Pioneer Metals Corporation in October

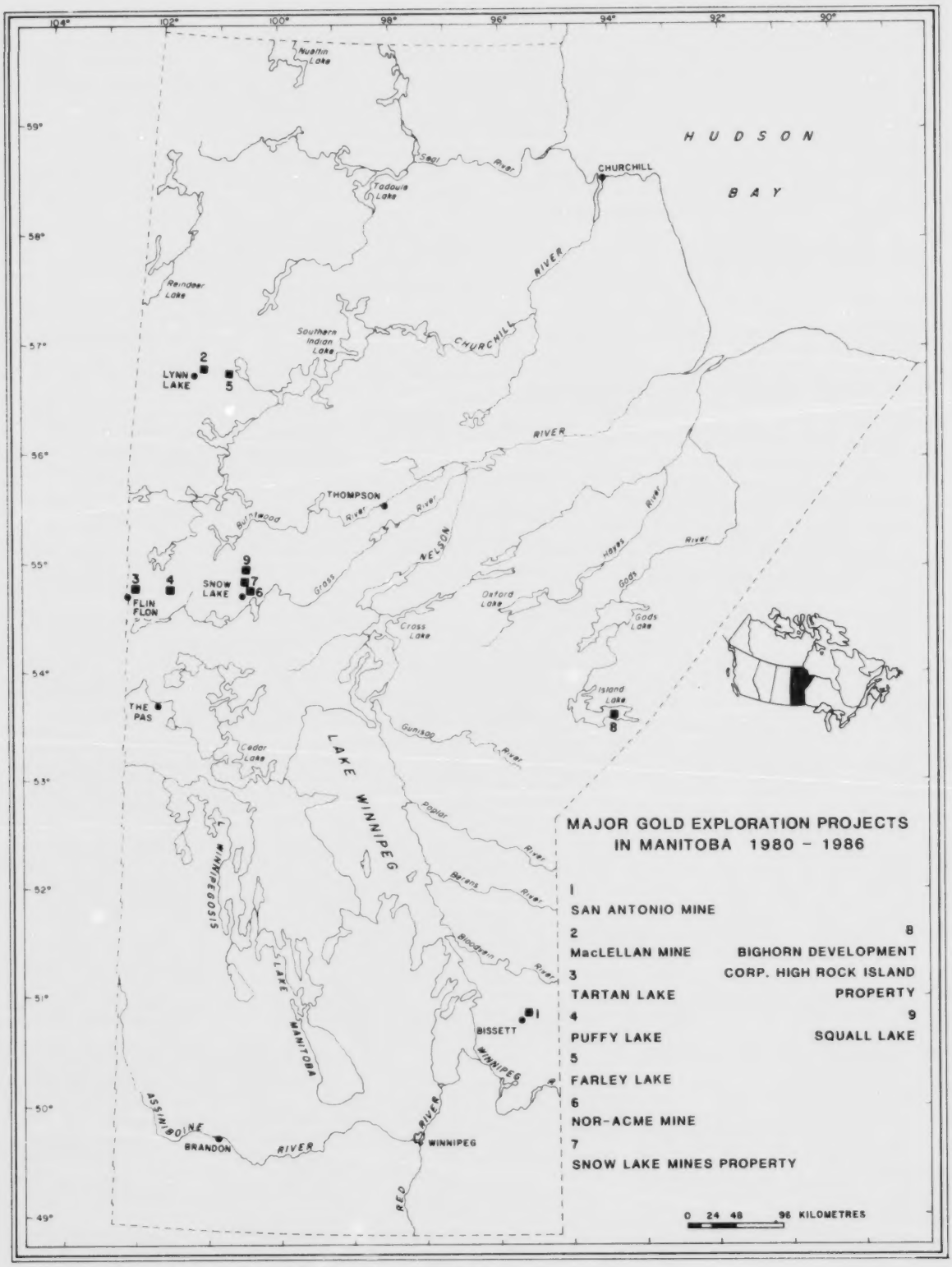


Figure 3. Major gold exploration projects in Manitoba: 1980-1986.

1986). Based on the results of an underground development program Pioneer Metals Corporation decided to put the deposit, which is estimated to contain 1.2 million tonnes averaging 7.89 g/tonne (0.23 oz/ton) gold, into production (Pioneer Metals Corporation, News release, January 19, 1987). They estimated that production will start in December 1987 and that when in full production the mine could produce 1244 kg (40 000 oz.) of gold annually.

In February 1986 Manitoba Mineral Resources Ltd. and Hudson Bay Exploration and Development Company Limited (HBED) announced the discovery of "widespread gold mineralization" at Farley Lake (Manitoba Mineral Resources, News Release, February 24, 1986). Diamond drilling carried out to test the extent of mineralization outlined several zones. The Wendy and East zones were estimated to contain combined geological reserves of 635 000 tonnes (700 000 tons) averaging 6.86 g/tonne (0.20 oz/ton) gold (Northern Miner, January 19, 1987).

In 1982 HBED estimated total indicated reserves of the Nor-Acme Mine to be 2 510 900 tonnes grading 5.49 g/tonne (0.16 oz/ton) gold (Northern Miner, July 22, 1982).

In 1986 San Antonio Resources, a joint venture between Inco Ltd. and Quest Resources, completed a 6127 m underground drill program at the San Antonio Mine. Resources at the mine are estimated to be 13 060 kg (420 000 oz.) of contained gold (Northern Miner, September 1, 1986, p. 2).

In 1986 Silver Hart Mines Ltd, through subsidiary Snow Lake Mines Ltd., commenced drilling on their Snow Lake property located just north of the Nor-Acme Mine. Hudson Bay Mining and Smelting Co., Limited, who dropped their option on the property in 1986, estimated Number 3 zone drill indicated reserves to total 200 000 tonnes grading 15.09 g/tonne (0.44 oz/ton) gold (George Cross Newsletter Ltd., No. 54, 1986). In March 1987 Snow Lake Mines announced the discovery of a new zone, located 1.2 km north-northwest of the No. 3 zone, with drill indicated reserves of 127 000 tonnes averaging 18.10 g/tonne (0.528 oz/ton) gold (Northern Miner, March 9, 1987).

Bighorn Development Corp. estimated drill indicated resources at its Island Lake property to total 316 000 tonnes averaging 15.43 g/tonne (0.45 oz/ton) gold (Northern Miner, November 3, 1986, p. 14).

Zenco Resources Inc. estimate their Squall Lake property, located 6 km north-northwest of Snow Lake, to contain 680 000 tonnes grading 3.43 g/tonne (0.1 oz/ton) gold (Northern Miner, January 10, 1985, p. 7).

ACKNOWLEDGEMENTS

The authors wish to acknowledge the supervision and guidance received from W.D. Fogwill and G.H. Gale of the Mines Branch and Geological Services Branch, respectively. Editing of the manuscript was done by W.D. Fogwill, J.D. Bamburak, G.H. Gale, and B.B. Bannatyne.

Valuable discussions were held with P. Theyer, D.A. Baldwin, E. Nielsen, M.A.F Fedikow and K. Ferreira of Geological Services Branch, T. Baumgartner of Hudson Bay Exploration and Development, N. Briggs of Manitoba Mineral Resources Ltd., N. Berg of Sherritt Gordon Mines Limited, B. Plecash (contract geologist at Puffy Lake) and J.C. Gibson; many offered constructive criticism on various parts of the text. P.J. Doyle, B. Esposito, I. Hosain and K. Filo of the Mines Branch provided useful information on past and present exploration and mining activities in the province. A special thanks is offered to those prospectors whose carefully kept scraps of paper, notebooks and files were donated to the Mines Branch corporation and unpublished information files; they are often the only source of information on exploration carried out before the late 1940s, when the first assessment reports were submitted to the department.

Drafting was very ably and patiently done by L. Graveley, under the supervision of E. Truman. Typing of the manuscript was done by A. Harasym, L. Chudy and D. Kircz.

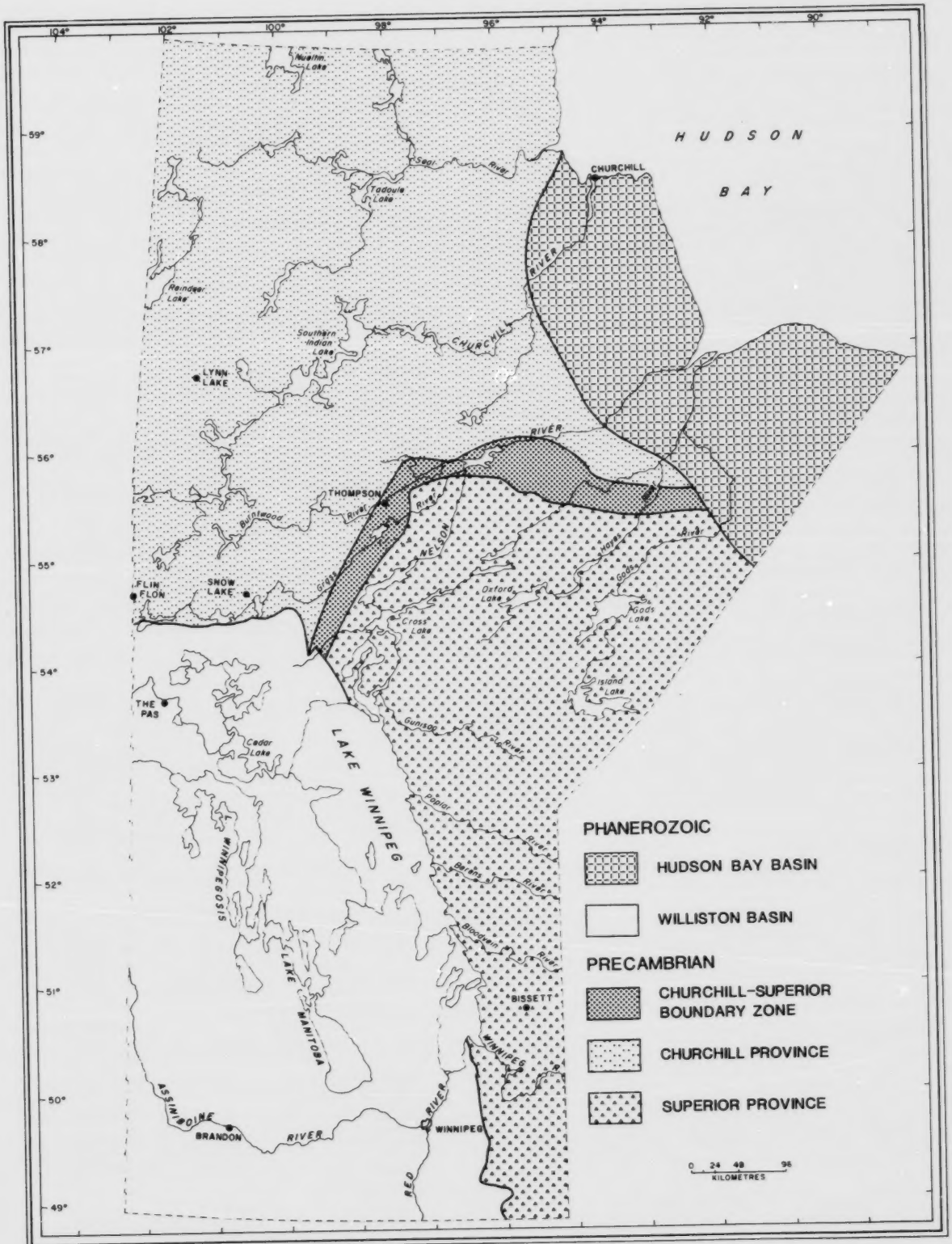


Figure 4. Geological subdivisions of Manitoba

REGIONAL GEOLOGY OF MANITOBA

The province of Manitoba occupies 650 000 km^2 and is divided into three major geological subdivisions: the Precambrian Shield, Hudson Bay Basin and Williston Basin *(Fig. 4)*. The Precambrian Shield covers 60% of the province's surface area and is the only region that has produced gold. This report will discuss the geology and gold deposits of the Precambrian Shield in Manitoba.

The Precambrian Shield is divided into the Churchill and Superior Structural Provinces; the zone of contact between the two provinces is known as the Churchill-Superior Boundary Zone.

SUPERIOR PROVINCE

Rocks that were deformed and metamorphosed by the Kenoran orogeny and yield Rb-Sr isotopic ages from 3000 to 2500 Ma form the northwestern part of the Superior Province in Manitoba.[1] The Superior Province is divided into a series of subprovinces characterized by four distinctive rock suites *(Fig. 5)*. The Wabigoon, Uchi, Island Lake and Gods Lake Subprovinces are characterized by the first type and consist of narrow, isoclinally folded east-trending belts of volcanic rocks, interlayered and overlain by sedimentary rocks, and intruded by granitic diapirs. The second style consists of a sedimentary gneiss belt, the English River Subprovince. The third style consists of migmatites, granite batholiths and subordinate volcanic and sedimentary rocks, as in the Molson Lake and Berens River Subprovinces. The Pikwitonei Domain represents the fourth style and comprises rocks of the Gods Lake Subprovince that have been overprinted by granulite facies metamorphism. The subprovinces are separated by faults or strongly metamorphosed boundary zones.

Gale et al. (1980) summarized the development of the Superior Province in a three step model: 1) development of volcanic terranes with bimodal composition; 2) erosion of these volcanic terranes and subsequent deposition of volcanic and other detritus into sedimentary basins at the margins of the volcanic belts; and 3) deposition of a younger succession of sediments, of probable fluviatile origin, unconformably on the volcanic sequences prior to the onset of the Kenoran orogeny(?) but following plutonic activity.

CHURCHILL PROVINCE

In Manitoba the Churchill Province is separated from the Archean craton of the Superior Province by the Churchill-Superior Boundary Zone. The Proterozoic southeastern part of the Churchill Province has been subdivided into: Flin Flon greenstone belt, Kisseynew sedimentary gneiss belt, Lynn Lake greenstone belt, Leaf Rapids greenstone belt, Southern Indian sedimentary gneiss belt and Chipewyan Batholith (Fig. 5). The northwestern part of the Churchill Province in Manitoba forms a broad zone of Proterozoic and Archean rocks lying between the Proterozoic southeastern part and the Archean craton of Churchill Province to the northwest in Saskatchewan and N.W.T.: it has been subdivided into the Wollaston sedimentary gneiss belt, Seal River sedimentary gneiss belt, Nejanilini Massif and Chipewyan Batholith.

Volcanic and volcano-sedimentary rocks (with abundant granitic intrusions) form the major components of the Flin Flon, Lynn Lake and Leaf Rapids greenstone belts. The Kisseynew, Southern Indian, Wollaston and Seal River sedimentary gneiss belts consist of thick sequences of paragneisses, migmatites, anatectic granitic bodies and minor amounts of volcanic rocks. The Chipewyan Batholith is an extensive body of granite, monzonite and granodiorite. The Nejanilini Massif consists of intermediate to basic gneisses and granulites.

The nature and evolution of the Early Proterozoic rocks in the southeastern part of the Churchill Province and the boundary zones with the Archean cratons have had a number of conflicting interpretations (Innes, 1960; Wilson and Brisbin, 1961, 1962; Bell, 1971; Gibb and Walcott, 1971; Dewey and Burke, 1973; Gibb, 1983; Baragar and Scoates, 1981; Fountain and Salisbury, 1981). The most recent model was proposed by Green et al. (1985) and represents one of a number of plausible models. Features of this model include: 1) rifting and rupturing of Archean cratons in the early Proterozoic followed by; 2) island arc volcanism (Flin Flon, Lynn Lake and Leaf Rapids belts) and deposition of sediments in fore-arc and back-arc basins (Kisseynew and Southern Indian sedimentary gneiss belts); 3) closing of these oceanic basins by subduction beneath the Flin Flon and Lynn Lake island arcs and opening of the South Indian Lake back-arc basin; 4) collision of the Superior craton with the Flin Flon island arcs; and 5) faulting along the Thompson Nickel Belt.

CHURCHILL-SUPERIOR BOUNDARY ZONE

The Churchill-Superior Boundary Zone consists of highly deformed Early Proterozoic-Archean gneisses and supracrustal rocks divided into three segments: Thompson Nickel Belt, Split Lake block and Fox River Belt. The Thompson Nickel Belt is underlain predominantly by migmatitic and layered cataclastic felsic gneisses. Narrow elongate lenses of metavolcanic, metasedimentary and ultramafic rocks of the Ospwagan Group occur within the migmatites and gneisses. The Split Lake block comprises cataclastic amphibolite, cataclastic granite to tonalite gneisses, anorthosite and layered mylonites (Corkery, 1985b). The Fox River Belt contains sedimentary rocks, large differentiated sills and ultramafic to mafic volcanic rocks that form a north-facing monoclinal sequence (Scoates, 1981).

[1]Ma is an abbreviation that means megayears before present; 3000-2500 Ma is the abbreviated form of writing 3000-2500 million years before present.

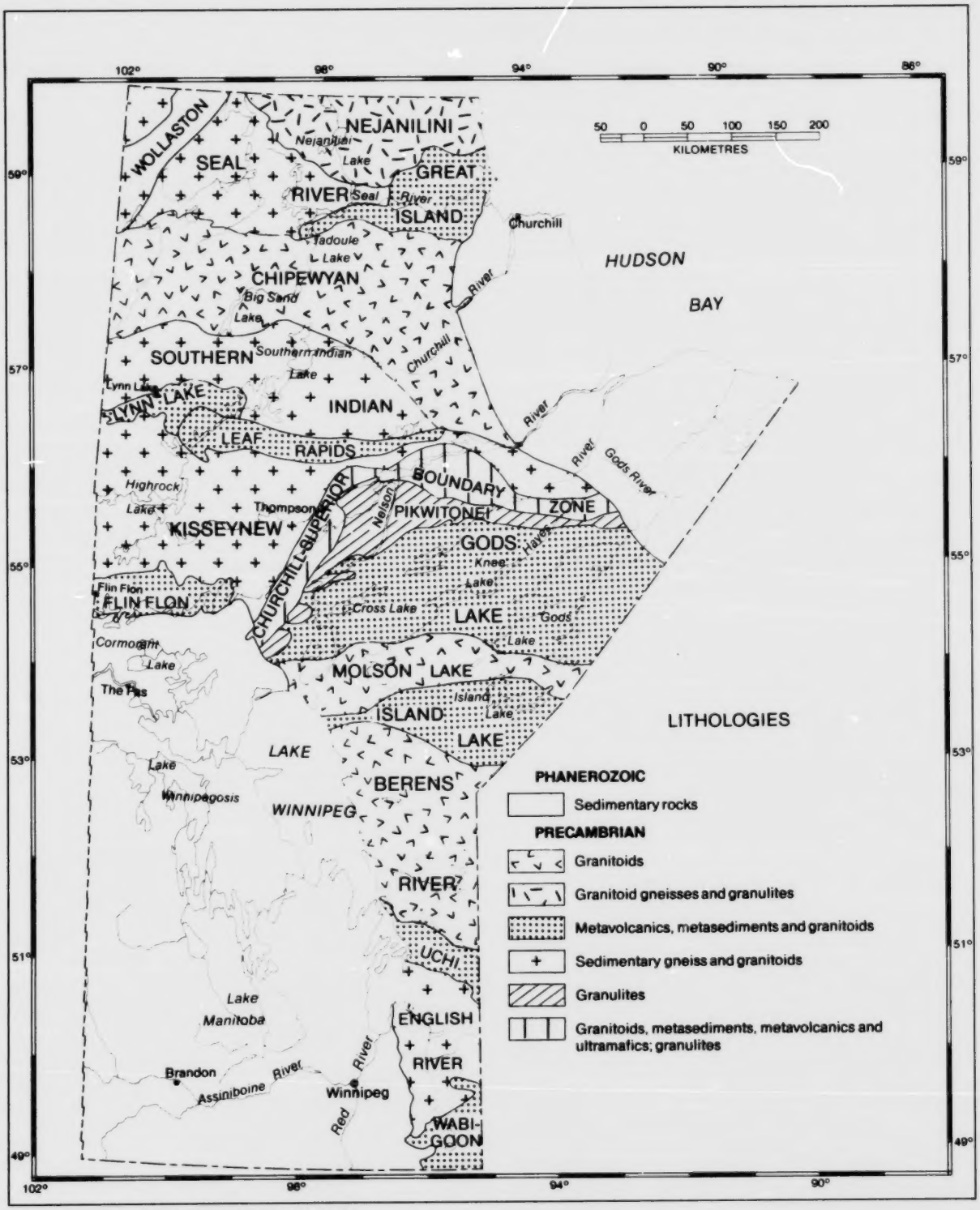


Figure 5. Geological subprovinces of Manitoba

WEST HAWK LAKE-FALCON LAKE-SHOAL LAKE AREA

REGIONAL GEOLOGY

Introduction

The West Hawk Lake-Falcon Lake-Shoal Lake area, situated in the western Wabigoon Subprovince, is a granite-greenstone terrain comprising volcanic and subordinate sedimentary rocks (Keewatin Series) intruded by granitoid rocks, some of batholithic dimensions. In Manitoba the Wabigoon Subprovince consists of two narrow greenstone belts that form southwesterly extensions of the greenstone belt in the Lake of the Woods area, Ontario: 1) the northern belt extends from the West Hawk Lake-Falcon Lake area in a southwest direction to the town of East Braintree where it passes beneath an extensive cover of glacial drift; and 2) the southern belt extends southwest from Indian Bay of Shoal Lake, beneath extensive glacial cover *(Fig. 6)*. Aeromagnetic maps indicate continuation of these belts beneath Paleozoic cover for 240 km to the west (Wilson, 1972).

Rb-Sr whole rock isotopic ages of the intrusive rocks bounding the greenstone belts indicate that a major intrusive event occurred between 2620 and 2665 Ma (Farquharson and Clark, 1971). A K-Ar determination on biotite from the Falcon Lake Igneous Complex gave an age of 2300 Ma (Wanless et al., 1968).

Keewatin Series

The Keewatin Series consists of calc-alkaline volcanic rocks, predominantly pillowed and massive andesite and basalt flows, interlayered with subordinate sedimentary rocks. Other volcanic rocks in the area are basic agglomerate, basic tuff, and lens-shaped rhyolite flows (Springer, 1952; Davies, 1954). Sedimentary rocks consisting of fine grained greywacke and minor argillite outcrop north of West Hawk Lake and Star Lake.

Intrusive Rocks

The greenstone belts are enclosed and separated by composite diapirs of granodiorite and quartz diorite.

Within the northern belt lens-shaped intrusive rocks, referred to as the Falcon Lake stock for a number of years, were interpreted by Brownell (1941), Davies (1954), Haugh (1962) and Gibbins (1971) to be a single phase intrusion. A study currently underway at the University of Manitoba and summarized by Mandziuk et al. (1986) has identified primary features that suggest a more complicated history of emplacement. The distribution of the different units and their relative ages suggest that the intrusive rocks formed as a result of several intrusive phases. The first phase of intrusion was probably "dyke-like" and was followed by intrusive phases that gave the complex a thicker more equant form *(Fig. 7)*. In the final stages of intrusion the active parts of the complex became progressively constricted towards the core. Mandziuk et al. (1986), Halwas (1984) and Fingler (1985, 1986) dropped the term "Falcon Lake stock" and renamed the intrusive body the "Falcon Lake Igneous Complex".

STRUCTURE

The northern greenstone belt is deformed by a series of arcuate folds with northeastto east-striking axes, apparently deflected by the intrusion of the Falcon Lake Igneous Complex. Numerous shear zones occur within the Keewatin Series rocks and are parallel to the fold axes or the margin of the igneous complex. Numerous steeply dipping shear zones also occur within the igneous complex at the contact between the inner core and the surrounding dioritic to granodioritic ring.

MINERALIZATION

In the West Hawk Lake-Falcon Lake-Shoal Lake area four small gold deposits (Sunbeam, FL1; Waverley, FL2; Thompson, FL3; Penniac Reef, FL4) and thirteen gold occurrences have been found (Fig. 6). Three of the deposits — Sunbeam, Thompson and Penniac Reef — produced a total of 34 kg (1093 oz.) gold.

The Sunbeam, Waverley and Penniac Reef deposits and all of the gold occurrences are spatially associated with the Falcon Lake Igneous Complex. The Sunbeam deposit (FL1) and Moonbeam occurrence (FL5) consist of gold-bearing breccia pipes that occur within the Falcon Lake Igneous Complex. The highest gold grades are associated with quartz stringers and gash veinlets that contain disseminated pyrite, irregular patches and grains of sphalerite, chalcopyrite, pyrrhotite and galena. Tetrahedrite, arsenopyrite and gold occur as small isolated grains associated with pyrite. The Waverley and Penniac Reef deposits and the gold occurrences consist of gold and sulphide-bearing quartz veins within the the Falcon Lake Igneous Complex and the adjacent Keewatin Series mafic volcanic rocks. Pyrite, pyrrhotite, arsenopyrite, sphalerite and galena are the most common sulphide minerals. Visible gold occurs locally. Assays of two "gold bars" produced from Penniac Reef indicated the presence of platinum and iridium (French, 1915).

The Thompson deposit consists of sheared and silicified andesite to basalt tuffs with gold-bearing quartz stringers. Mineralization within the shear zone is discontinuous along strike, occurs over widths of less than 2 m, and consists of disseminations and stringers of pyrite with lesser amounts of pyrrhotite, chalcopyrite and visible gold.

PAST PRODUCERS

Sunbeam (FL1) and Waverley (FL2)

Location: 135 km east of Winnipeg, 0.8 km south of Star Lake.

Map Reference: Fig. 6 and 8, locations FL1, FL2

Description of Sunbeam Deposit:

The Sunbeam deposit consists of a silicified, sericitized, propylitized and slightly carbonatized quartz monzonite breccia pipe. In plan view the deposit is roughly elliptical at surface with an area of about 200 m^2 (Fig. 8). The pipe plunges at 55-65 in the direction 330 .

Halwas (1984) and Fingler (1985) recognized four zones in the area of the breccia pipe: 1) an outer zone of widely spaced concentric sheet fractures in propylitized quartz monzonite; 2) a zone of more closely spaced concentric fractures with intense sericitic and carbonate alteration; 3) fragments of extensively sericitized and silicified quartz monzonite within a matrix of comminuted quartz monzonite, disseminated sulphides with gold, and gold-bearing quartz veins; and 4) a more extensively mineralized breccia similar to zone three above.

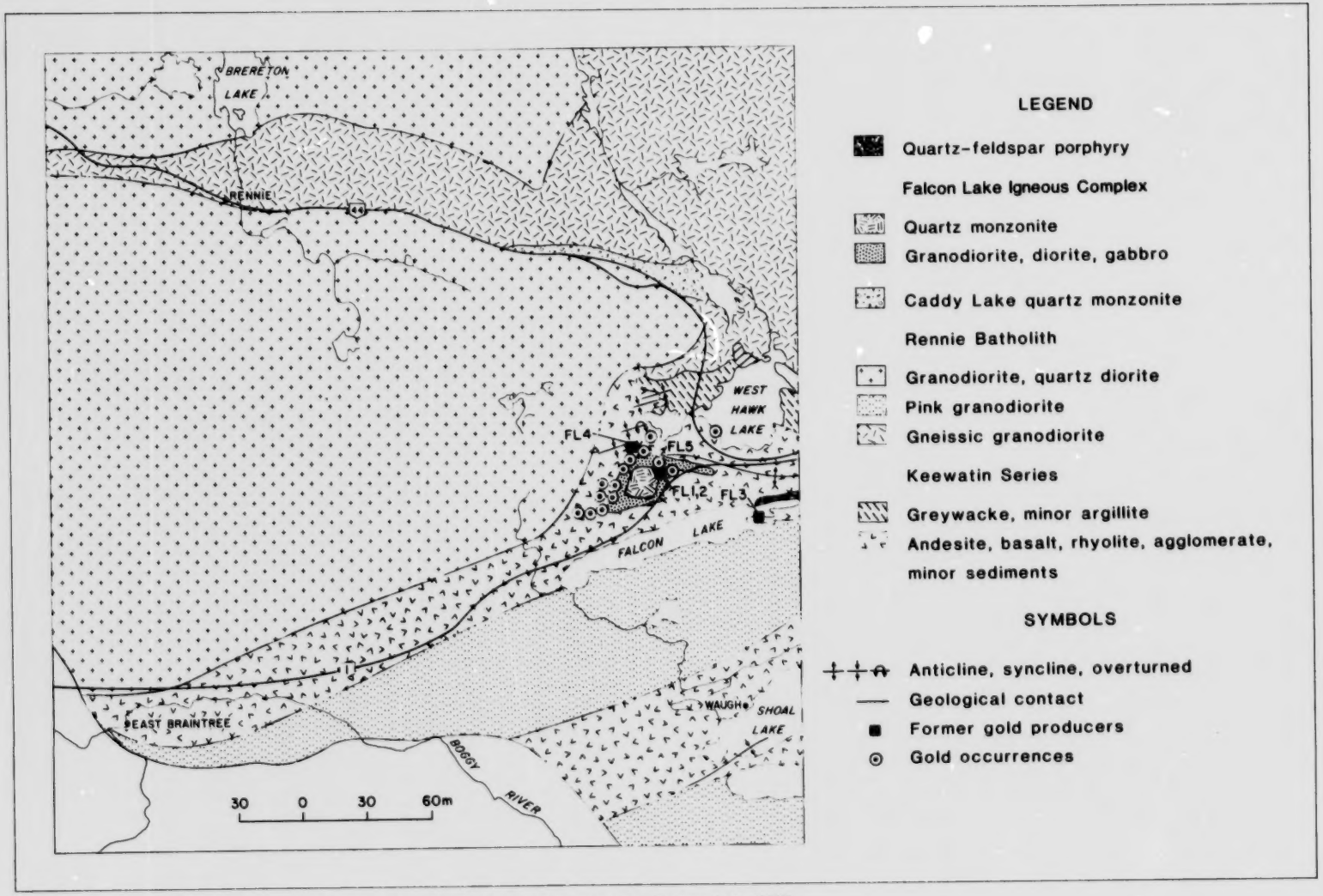


Figure 6. General geology of the Falcon Lake-West Hawk Lake-Shoal Lake area (after Davies et al., 1962).

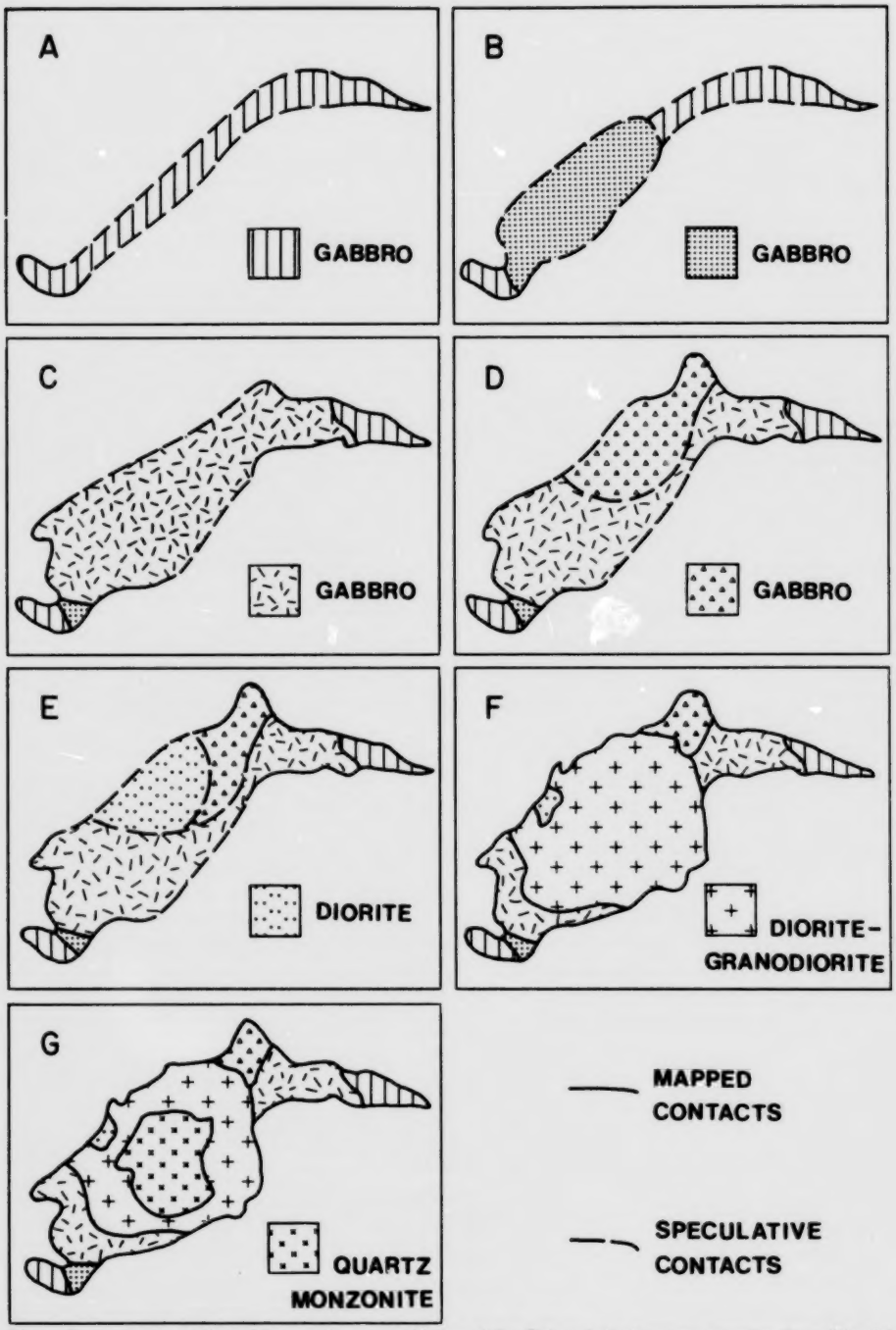


Figure 7. Interpretation of the emplacement history of the Falcon Lake igneous complex (from Mandziuk et al., 1986).

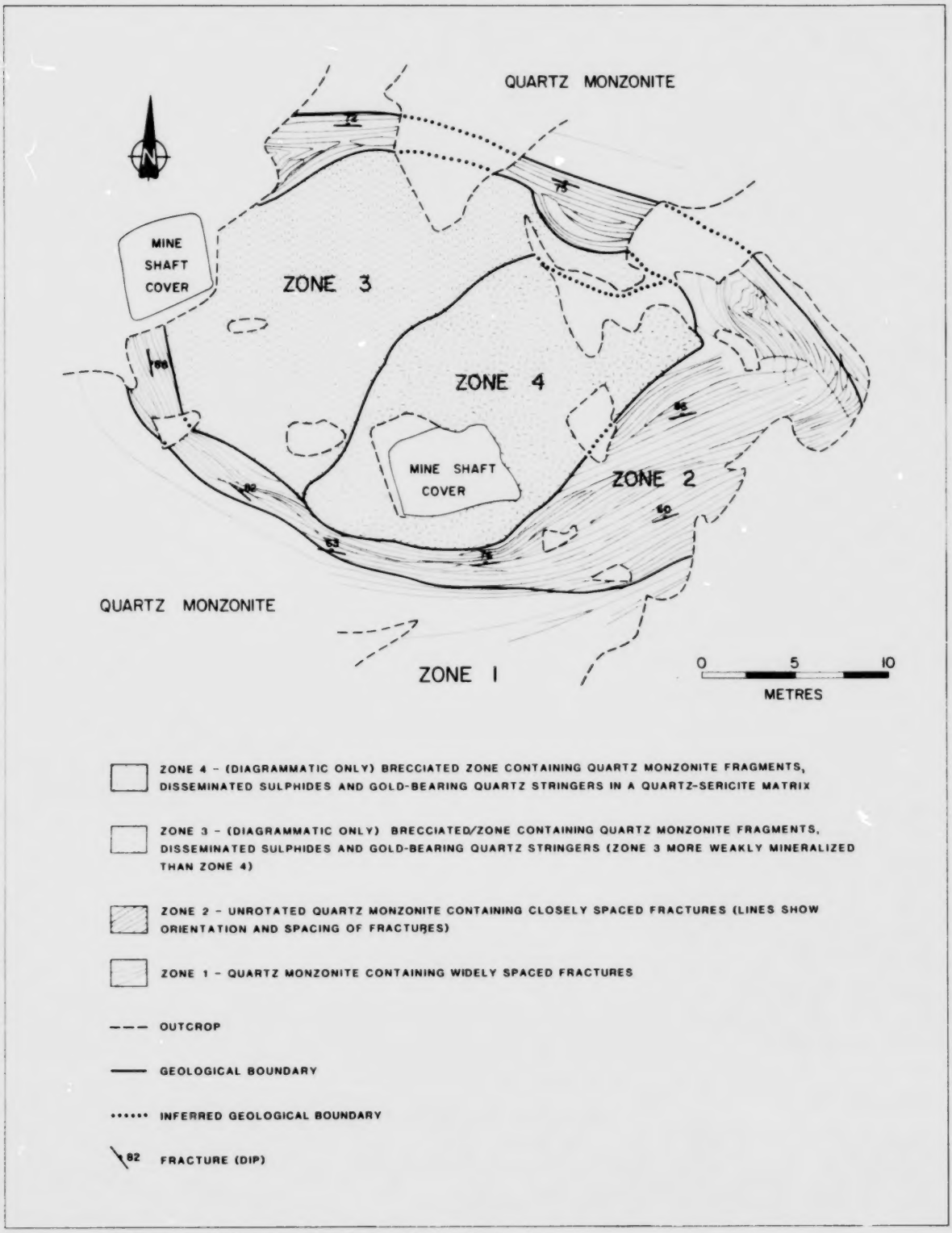

QUARTZ MONZONITE
MINE SHAFT COVER
ZONE 3
ZONE 4
MINE SHAFT COVER
ZONE 2
QUARTZ MONZONITE
ZONE 1
0 5 10
METRES
ZONE 4 - (DIAGRAMMATIC ONLY) BRECCIATED ZONE CONTAINING QUARTZ MONZONITE FRAGMENTS, DISSEMINATED SULPHIDES AND GOLD-BEARING QUARTZ STRINGERS IN A QUARTZ-SERICITE MATRIX
ZONE 3 - (DIAGRAMMATIC ONLY) BRECCIATED/ZONE CONTAINING QUARTZ MONZONITE FRAGMENTS, DISSEMINATED SULPHIDES AND GOLD-BEARING QUARTZ STRINGERS (ZONE 3 MORE WEAKLY MINERALIZED THAN ZONE 4)
ZONE 2 - UNROTATED QUARTZ MONZONITE CONTAINING CLOSELY SPACED FRACTURES (LINES SHOW ORIENTATION AND SPACING OF FRACTURES)
ZONE 1 - QUARTZ MONZONITE CONTAINING WIDELY SPACED FRACTURES
OUTCROP
GEOLOGICAL BOUNDARY
INFERRED GEOLOGICAL BOUNDARY
82 FRACTURE (DIP)

Figure 8. Geology of the Sunbeam breccia pipe (from Fingler, 1985).

Mineralization consists of pyrite and pyrrhotite with lesser amounts of arsenopyrite, sphalerite, galena, tennantite, chalcopyrite and minor associated free gold.

A flatly dipping fault displaces the lower part of the deposit 20 m to the north. Several other northeast-trending fractures displace the deposit for distances of a few centimetres to several metres.

Halwas (1984) proposed multi-stage development for the breccia pipes consisting of: 1) upward migration of a high pressure fluid in a conduit within quartz monzonite causing alteration and exerting compressive strain on the wall rocks; 2) an implosion caused by boiling of the fluid when an area of low confining pressure was reached; 3) decompression followed by deposition of quartz in fractures and breccia; 4) migration of hydrothermal fluid followed by a second implosion; 5) following decompression gold-bearing quartz and sulphides were deposited in the fractures and breccia.

Description of the Waverley Deposit:

The area is underlain by sheared quartz monzonite. Fingler (1986) mapped three shear zones: the W1 and W2 shears strike 050-061 and dip 62-66 SE, the W3 shear strikes 095 , with an undetermined dip. The shears range in width from 2 to 8 m and consist of multiple gold and sulphide-bearing quartz veinlets up to 1 cm in width.

History of Exploration and Development:

The Sunbeam and Waverley deposits were first staked in 1912 and 1913. Exploration of the claims between 1912 and 1928 consisted of sampling and trenching. In 1923 eighteen channel samples were taken from three open cuts on Sunbeam. Each sample was taken over a 0.1 m width, spaced every 1.5 m along the bottom of the cuts. The average assay of these samples was 21.94 g/tonne (0.64 oz/ton) gold. From 1928 to 1934 a minor amount of shaft sinking and diamond drilling was carried out.

In 1936 surface trenching and a 1525 m 28-hole diamond drill program was undertaken on the Sunbeam claim. A total of 69 channel samples taken over an area of 93.5 m^2 averaged 13.03 g/tonne (0.38 oz/ton) gold. Core and sludge samples taken across the mineralized zone in four holes averaged 10.29 g/tonne (0.3 oz/ton) gold over 8.54 m. In 1938 an inclined shaft was sunk to a depth of 134 m with stations cut at 30, 61, 92 and 130 m. Wright (Manitoba Mines Branch, Corporation File, Goldbeam Mines Limited) estimated reserves to total 99 800 tonnes with an average grade of 8.91 g/tonne (0.26 oz/ton) gold. In 1940 a 4257 tonne bulk sample shipped to a mill near Kenora, Ontario produced 24.7 kg (794 oz.) gold. A dispute arose over the amount of gold extracted; no further ore shipments were made.

Goldbeam Mines Limited acquired the property in 1941. A 91-hole 8522 m drill program discovered a series of six lenticular veins, later named the Waverley deposits (Goldbeam Mines Limited, Annual Report, 1945). This increased drill indicated reserves to 500 000 tonnes averaging 10.04 g/tonne (0.29 oz/ton) gold. In 1946 a 3-compartment vertical shaft was completed to a depth of 137 m with levels at 46, 92 and 137 m. Operations were discontinued in late 1946.

From 1950 to 1976 a number of prospectors and companies held the property, including: Homestake Explorations Limited, A.D. Skogsberg, Hugh Currie and Star Lake Gold Mines, Limited. Very little exploration work was carried out during this period.

In 1976 Whiteshell Ventures Ltd. acquired the property and carried out a 5-hole 173 m drill program. In 1981 Goldbeam Resources Ltd., Whiteshell Ventures' parent company, commenced an exploration program that included detailed sampling of outcrop, testing of the depth potential of the deposit, dewatering of the shaft and underground drilling. Whiteshell Ventures rehabilitiated the old shaft in 1985.

History of Production:

Year	Tonnes milled	Grade g/tonne (oz/ton) gold	
1936	4438 tonnes	5.83	(0.17)

Source: Manitoba Mines Branch, Corporation Files (Goldbeam Mines Limited)

Selected Bibliography: Bruce (1919); Davies (1954); DeLury (1927); Fedikow (1981); Manitoba Mines Branch, Annual Report on Mines and Minerals (1928-1931), Corporation File (Goldbeam Mines Limited), Mineral Inventory File (52 E 11NW Au2.3), Non-confidential Assessment File (91079); Springer (1952); Stewart (1977).

Thompson No. 2

Location: 141 km east of Winnipeg, east end of Falcon Lake.

Map Reference: Fig. 6, location FL3.

Description of Deposit:

The deposit consists of a mineralized shear zone that occurs in andesite and basalt flows and tuffs (Davies, 1954). The shear zone strikes 082 , dips vertically and is up to 3.7 m wide. Mineralization within the shear zone is discontinuous along strike and generally occurs in the central silicified part of the shear over widths of 0.5 to 1.2 m. Mineralization consists of disseminations and stringers of pyrite with lesser pyrrhotite, chalcopyrite and locally visible gold.

History of Exploration and Development:

The property was first staked in 1937 by Vimy Richards and then optioned by Oliver Severin Gold Mines Limited in late 1937. Surface trenching encouraged the company to carry out a 20-hole drill program. In 1939, 39 tonnes of ore hauled to Kenora for milling produced 1.88 kg (60.47 oz.) gold.

From 1941 to 1946 various prospectors and companies held the property, including: Wendigo Gold Mines, R.S. Cohoon, J.E. Thompson, Sylvanite Gold Mines Limited (NPL), J.E. Thompson Jr. and Newcor Mining and Refining Limited. Newcor completed a 2-hole drill program in 1949; a sample from the first hole assayed 42.91 g/tonne (1.25 oz/ton) gold from 13.73 to 14.49 m.

Falnora Gold Mines Ltd. (NPL) acquired the property in 1950. Dawson (1950) concluded that mineralization, where exposed, extends for 162 m — the eastern 76 m averaging 15.09 g/tonne (0.44 oz/ton) gold over 0.64 m, and the western 85 m containing a much lower gold content. Mitchell Mines Ltd. was formed to continue work on the Thompson claims. A total of 15 holes were drilled; significant drill results are summarized as follows:

Drill Hole	Depth	Grade g/tonne (oz/ton) gold	
K1	9.46-10.37	7.54	(0.22)
K3	12.05-12.35	14.40	(0.42)
	12.35-13.01	360.71	(10.52)
	13.01-14.28	25.72	(0.75)
	14.28-14.59	1.03	(0.03)
	15.05-15.86	3.77	(0.11)
K4	12.66-13.27	126.87	(3.70)
	13.27-14.03	33.60	(0.98)
	14.03-14.49	6.17	(0.18)
K6	12.63-13.52	25.72	(0.75)
K7	10.98-11.54	24.00	(0.70)
B1	28.85-29.16	18.52	(0.54)
B9	33.79-34.01	5.83	(0.17)

Source: Manitoba Mines Branch, Non-confidential assessment file 91070.

The results were considered discouraging and the property was dropped in 1968.

The property was held by J. Donner and T. Burke-Gaffney from 1968 to 1971. Ed Roberecki staked the property in 1979 and from September 1980 to June 1984 rehabilitated the open-cut and carried out chip sampling.

History of Production:

Year	Quantity in tonnes (tons)	Grade g/tonne (oz/ton) gold
1939	39.01 (43)	48.21 (1.41)

Source: Manitoba Mines Branch, annual report 1939, p. 82.

Selected Bibliography: Canadian Mines Handbook (1967-1968); Davies (1954); Fedikow (1981); Manitoba Mines Branch, Annual Reports (1938, 1940, 1951-52), Mineral Inventory File (52 E/11NE Au1), Non-confidential Assessment File (91070); Springer (1952).

Penniac Reef (Moore)

Location: 132 km east of Winnipeg, 0.8 km southwest of Star Lake.

Map Reference: Fig. 6, location FL4.

Description of Deposit:

The deposit consists of quartz stringers within a shear zone in basic agglomerate. The shear zone strikes 035-045 and dips steeply to the northwest. Mineralization consists of pyrite, chalcopyrite and arsenopyrite.

History of Exploration and Development:

The property was first staked as the Moore claim in 1890. A 3.2 kg sample taken in 1904 or 1905 assayed 181.7 g/tonne (5.30 oz/ton) gold with a trace of silver. A shaft was started and some trenches made.

In 1910 the property was restaked by George Knudson and later assigned to The Penniac Reef Gold Mines, Limited. Thurber (1911) and Jeffrey (1912) sampled the dumps and trenches. Samples of vein and selected dump samples assayed from 5.77 g/tonne (0.17 oz/ton) to 403.96 g/tonne (11.78 oz/ton) gold. The shaft was deepened to 27 m and a 9.1 tonne amalgam mill was installed. It was reported that about 272 tonnes of material was milled to produce two gold bars, with an unknown amount of gold. An assay of the second bar yielded 49.25% gold, 2.25% platinum, 0.25% iridium, 15.5% silver, and 32.75% copper and iron (French, 1915).

Star Lake Gold Mines Limited acquired the property in 1916 and carried out 28 m of drifting on the 25 m level. The only exploration carried out since 1917 was a 488 m drill program that was completed in 1938.

History of Production:

272 tonnes averaging 23.3 g/tonne (0.68 oz/ton) gold
Source: Manitoba Mines Branch, Coporation File, (Star Lake Gold Mines Limited.

Selected Bibliography: Davies (1954); Delury (1927); Jeffrey (1912); Manitoba Mines Branch, Annual Report on Mines and Minerals (1939), Corporation File (Star Lake Gold Mines Limited), Mineral Inventory File (52 E/11NW Au 4); Springer (1952).

RICE LAKE GREENSTONE BELT

REGIONAL GEOLOGY

Introduction

The Archean Rice Lake volcanic-sedimentary (greenstone) belt is situated in the Superior Structural Province of the Canadian Shield and extends in an arcuate southeasterly trend from the east shore of Lake Winnipeg to its eastern termination in Ontario approximately 25 km from the Manitoba/Ontario provincial boundary (Map ER86-1-1; Shklanka, 1967).

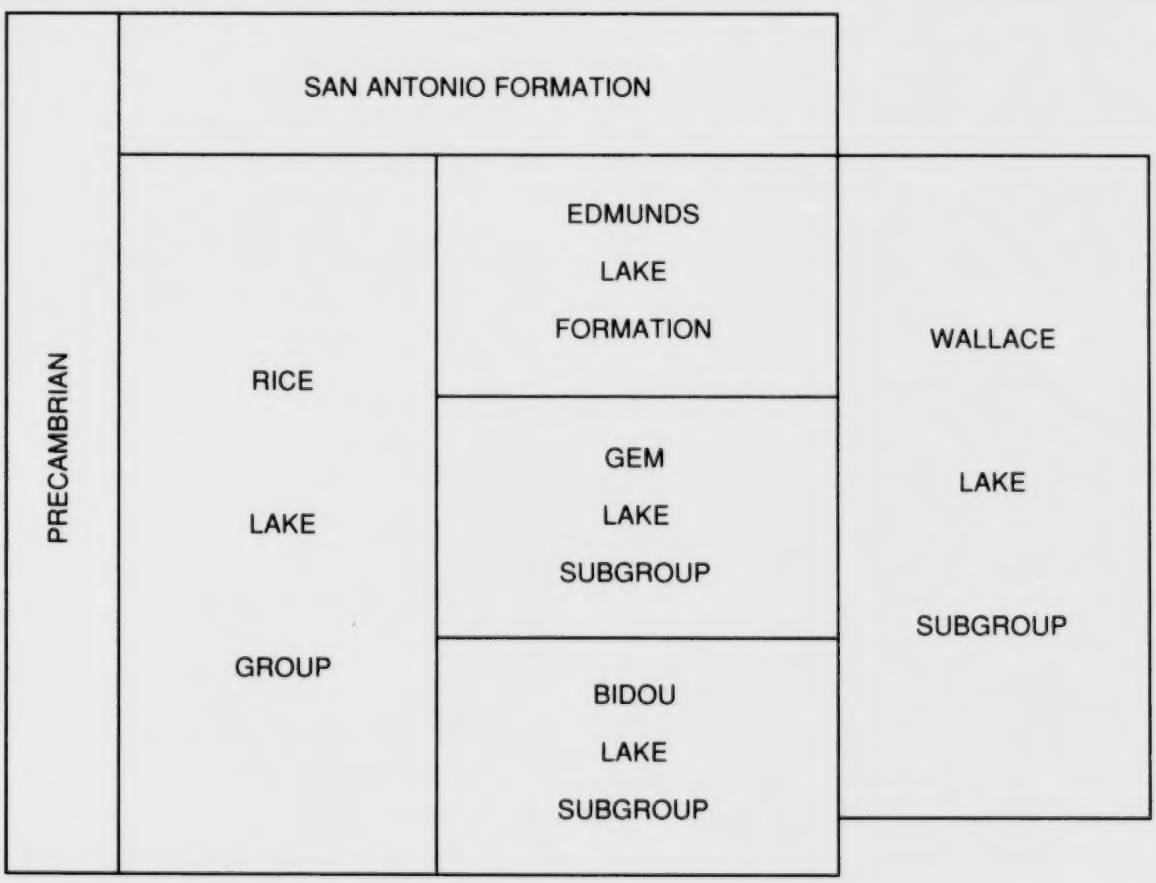
The Rice Lake greenstone belt is in fault contact to the north with the Wanipigow River plutonic complex and comformably overlain on the south by the Manigotagan gneissic belt (McRitchie,1971a). The supracrustals of the Rice Lake belt have been divided into the volcanic and derived sedimentary rocks of the Rice Lake Group (Stockwell, 1945a) and the overlying sedimentary rocks of the San Antonio Formation (Stockwell,1938).

Mafic dykes and sills and quartz diorite-granodiorite batholiths intrude the Rice Lake Group.

Rice Lake Group

The volcano-sedimentary rocks of the Rice Lake Group have been subdivided locally into the older Bidou Lake Subgroup and the younger Gem Lake Subgroup (Weber, 1971; *Table 2*). Each subgroup consists of a volcanic sequence overlain by the eugeosynclinal sedimentary rocks of the Edmunds Lake Formation. The Wallace Lake subsidiary greenstone belt (Map ER86-1-1) is separated from the main greenstone belt by the Wanipigow-Wallace Lakes fault (McRitchie, 1969). McRitchie (1971b)

TABLE 2
TABLE OF GENERALIZED STRATIGRAPHIC UNITS,
condensed from McRitchie et al. (1971a) and Weber (1971)



defined the sequence of rocks in the Wallace Lake subsidiary greenstone belt as the Wallace Lake Subgroup.

Campbell (1971) subdivided the Bidou Lake Subgroup and the Gem Lake Subgroup into a total of eight formations. The Bidou Lake Subgroup is characterized by a bimodal volcanic sequence (basalt-dacite) and derived sedimentary rocks. The Gem Lake Subgroup is characterized by a complete volcanic differentiation cycle (basalt-andesite-dacite-rhyolite) and interlayered sedimentary rocks. Seneshen and Owens (1985) defined an additional formation consisting of graded tuffaceous sandstones, mudstones, feldspathic sandstones and intercalated volcanic rocks at the stratigraphic top of the Bidou Lake Subgroup. Both subgroups are overlain by the eugeosynclinal argillites and greywackes of the Edmunds Lake Formation.

The Bidou Lake Subgroup and equivalent rocks are laterally extensive and have been correlated throughout the main portion of the greenstone belt. In contrast, the Gem Lake Subgroup and equivalent rocks occur locally and may indicate restricted volcanism or extensive erosion.

The mafic and felsic volcanic units of both subgroups differ in their mode of deposition and chemical affinity. Weber (1971) interpreted the mafic volcanic rocks as being pillowed and massive volcanic flows exhibiting a distinct tholeiitic affinity. In contrast, the felsic volcanic units are interpreted to be predominantly pyroclastic deposits and chemically fall within the calc-alkaline igneous field.

Stratigraphy in the Wallace Lake subsidiary greenstone belt exhibits a regional transition from basal mafic volcanic and felsic-intermediate volcanic-derived sedimentary rocks to an overlying sedimentary sequence of arkose, quartzite and greywacke interlayered with conglomerate, silicified limestone, and iron formation. McRitchie (1971b) has interpreted this rock succession as having been deposited in a miogeosynclinal shallow water environment.

San Antonio Formation

Immediately west and northwest of Rice Lake the Rice Lake Group and associated intrusions are unconformably overlain by the arkosic sandstones and conglomerates of the San Antonio Formation. Deposition of the San Antonio Formation postdates the first major deformational event recognized in the Rice Lake Belt, i.e., large-scale D_1 isoclinal folding.

Intrusions

The Rice Lake Group has been intruded by a variety of gabbroic and diabasic sills and dykes, felsic plugs, granitoid plutons and related quartz-feldspar porphyry dykes and minor ultramafic intrusions.

Mafic intrusive rocks occur more commonly within the mafic than the felsic volcanic or sedimentary rocks of the Rice Lake Group and represent the oldest intrusive rocks within the greenstone belt. The gabbros occur as sill-like intrusions and exhibit a close compositional, chemical and spatial affinity to the mafic extrusive rocks (Weber, 1971). The diabase dykes or sills are considered to be post volcanism and younger than the gabbro.

Felsic plugs and plutons intrude all rocks of the Rice Lake Group. The felsic plugs are commonly associated with the rhyolite units of the Gem Lake Subgroup. Two large quartz diorite plutons intrude the central part of the greenstone belt east and west of Rice Lake. The oval-shaped Ross River pluton outcrops to the east, and to the west a more elongate body of similar composition occurs. A phase of porphyry dyke intrusion followed emplacement of the quartz diorite plutons.

Turek et al. (1985) using U-Pb determinations on zircons have determined similar ages (2712-2765 Ma) for the Ross River Pluton, a northern granite from the Wanipigow River plutonic complex and a Bidou Lake dacite indicating all were probably formed during the same magmatic event.

Scoates (1971) observed three types of ultramafic intrusions in the Rice Lake area: 1) a discontinuous series of serpentinized lenses within the Wanipigow River plutonic complex; 2) a straight-walled cortlandtite dyke at Dove Lake; and 3) a slightly differentiated layered ultramafic intrusion at Garner Lake. Isolated occurrences of ultramafic rock outcrop on the north shore of Wallace Lake, east of Siderock Lake and east of Beresford Lake (McRitchie, 1971a). With the exception of the cortlandtite dyke all of the ultramafic occurrences are located adjacent to or along the north flank of the Rice Lake greenstone belt. Outcrops of the ultramafic lenses occupy positions along a topographic linear, thought to be a western extension of the Wanipigow-Wallace Lakes fault, and outcrop over a distance of approximately 25 km. The cortlandtite dyke and layered ultramafic rocks have intruded folded rocks of the Rice Lake Group and indicate a post-D_1 emplacement. More recently, Theyer (1983) has identified a sequence of chemical and clastic sedimentary rocks with an interlayered spinifex textured ultramafic unit in the Wallace Lake area, and Brown (in press) has identified conformable serpentinized ultramafic units in outcrop near the western limit of the exposed greenstone belt.

METAMORPHISM

Although several phases of metamorphic recrystallization have been recognized in this region (McRitchie and Weber, 1971) the majority of rocks in the Rice Lake greenstone belt exhibit mineral assemblages indicative of greenschist facies metamorphism. Metamorphic grade increases at the northern margin of the belt due to the thermal effects of igneous activity during emplacement of the Wanipigow River plutonic complex. On the southern flank of the belt regional metamorphic grade increases southward as evidenced by a lithologic gradation from low grade Edmunds Lake Formation rocks to high grade gneisses of the Manigotagan gneissic belt. Contact metamorphic aureoles asssociated with the quartz diorite intrusions are preserved locally.

STRUCTURE

McRitchie and Weber (1971) and Zwanzig (1971) have recognized six periods of deformation in the rocks of the Rice Lake greenstone belt including three periods of folding. Interlayering or repetitions of beds evidence D_1 large-scale isoclinal folding with generally shallow axes plunging to the northwest. D_2 deformation is characterized by: 1) small-scale, similar, mainly Z-shaped folds; 2) development of a penetrative foliation (S_2) parallel to the axial planes of the D_2 folds; and 3) flattening of pyroclastic and conglomeratic fragments in the foliation plane with elongation parallel to the fold axes. Foliation and deformation of fragments produced during D_2 deformation exist in most parts of the greenstone belt. Small-scale concentric S-shaped folds developed during D_3 deformation.

Continued movement along S_2 planar fabrics during D_4 deformation may be responsible for the main break between the Manigotagan gneissic and greenstone belts. North-south maximum compressive stress, developed in association with isostatic imbalance and upward movement of the English River (Manigotagan) sedimentary pile, produced major, steeply dipping conjugate northwest-northeast shear zones within the greenstone belt during D_5 deformation. With decreasing confining pressures rectilinear D_6 microbrecciation fractures and ultramylonitic zones developed that dislocated all earlier structures. The main movement along the Wanipigow-Wallace Lakes fault is attributed to D_6 deformation.

MINERALIZATION

In the Rice Lake greenstone belt gold occurs in veins and stringers of quartz that occupy shears, faults and fractures within rocks of the Rice

Lake Group and associated intrusions. Gold-bearing quartz veins occur in essentially all rock types but are best developed in the more massive and structurally competent diabase, gabbro, dacite and basalt units.

Vein Formation

Formation of the quartz veins took place late in the tectonic history of the greenstone belt and postdate the last major period of folding (D_3) and emplacement of the associated intrusions. Development of northwest-striking, steeply dipping conjugate shears and related dilational structures during the D_5 deformation event provided depositional sites for the majority of the gold-quartz veins in the Rice Lake greenstone belt. D_6 deformation produced localized kinking and granulation of quartz veins and some remobilization of gold.

Vein Distribution

Gold-quartz veins are concentrated in the greenstone belt east and west of the oval-shaped Ross River Pluton (Map ER86-1-1, in pocket). Structural interference caused by the rigid or deformation-resistant Ross River pluton during D5 north-south compressive stress created symmetrically disposed shears and fractures in the adjacent greenstone belt and local deformation at the pluton margins. Gold-quartz vein formation in the Wallace Lake subsidiary greenstone belt appears to have been contemporaneous with vein formation in the main part of the greenstone belt. The Vanson deposit (Map ER86-1-1, location RL14) and a few small gold occurrences exhibit a spatial relationship to the Wanipigow-Wallace Lakes fault and are probably related to mobilization of gold during D_6 deformation. The San Antonio Formation is devoid of gold-bearing quartz veins.

Vein Form

The nature of individual gold-quartz deposits is determined by the character of the host shear or fracture zone. Shear zones typically do not exceed 3 m in width and approximately 70 m in length (Stockwell, 1938). In general, vein material is irregularly distributed along a portion of any particular shear zone as discontinuous lenses, pods, stringers and or pinch and swell veins. The quartz may be distributed across a portion or the entire width of the structural zone. Vein dimensions, as with vein styles, are extremely variable due to the tectonic nature of the depositional sites. In general, most veins, lenses, series of lenses or stockworks seldom exceed 1 m in width and 100 m in strike length. The northeast-trending ore shoots of the San Antonio deposit *(Fig. 9, in pocket)*, form discrete elongate bodies and/or a discontinuous series of lenses at or near the centre of the shear zone and, in general, are accompanied by numerous quartz stringers that branch out from the main vein or parallel the shear cleavage. Cataclastic banded or ribboned structures and contained ore minerals, gangue minerals and wall rock are ubiquitous within the quartz veins and are associated with continued shear stress during vein emplacement or with later, renewed movement along the vein.

The majority of gold-quartz veins in the Rice Lake greenstone belt are hosted by shear zones. Less common are the breccia zone and tensional fracture hosted gold-quartz veins that commonly form the northwest-trending ore shoots of the San Antonio deposit. The breccia zones exhibit no apparent displacement of hanging wall relative to footwall and are characterized by irregular stockworks or networks of quartz stringers. Discrete tabular quartz bodies with or without branching quartz stringers were deposited in the tensional fracture sites.

Vein Mineralogy

Accessory ore and gangue minerals normally account for up to 10% of vein material. Gold, pyrite, chalcopyrite, pyrrhotite, sphalerite, arsenopyrite and galena are the most prominent ore minerals. Pyrite is the most common sulphide and occurs as coarse subhedral crystals or as fine granulated streaks and bands. The coarse pyrite crystals contain blebs of gold along internal fractures and on crystal faces. Gold occurs interstitially to the fine pyrite granules and as blebs in relic crystal fragments within the pyrite streaks and bands. Chalcopyrite is a common ore mineral and other sulphides occur locally. Iron oxide minerals have been observed in only one or two localities. Quartz is the second most important carrier of gold and the dominant gangue mineral. Stephenson (1972) noted that the undeformed barren or poorly mineralized veins typically contain white glassy quartz. Cataclastic sugary or cherty varieties of quartz with interstitial gold and sulphides are more common in the ore-bearing deposits. The most common gangue minerals are ankerite, chlorite, sericite and tourmaline. Albite, K-feldspar, calcite, fuchsite and epidote are also present.

Ore and gangue mineral relationships indicate that the majority of gold and pyrite was precipitated with early quartz, albite and tourmaline (Stephenson, 1971). Ankerite deposition occurred during all stages of vein development. Cataclasis during and or after vein emplacement facilitated the liberation of the early precipitated gold from its pyrite host by mechanical granulation and, in some cases, the introduction of telluride minerals. Wisps, long slivers and thin slices of stress minerals such as chlorite, sericite and fuchsite separate cataclastic quartz layers.

Wall Rock Alteration

Hydrothermal alteration of wall rock material adjacent to mineralized quartz veins seldom extends more than 3-7 m from the vein margin and normally can be subdivided into an inner and outer visible alteration zone (Stephenson, 1971). The invariably sheared inner zone is characterized by intense sericitization, chloritization, pyritization, carbonatization and silicification. Its thickness ranges from a few centimetres to a metre in width. The wall rock in the outer zones commonly exhibits partial preservation of primary mineralogy. The intensity of alteration is controlled to a great degree by the composition of the host rock. In general, the mafic host rocks are more susceptible to hydrothermal alteration.

Summary

Gold deposits of the Rice Lake greenstone belt are structurally controlled and predominantly of the epigenetic quartz vein type. Depositional sites for the gold-quartz veins were developed in the competent rock units of the Rice Lake Group through brittle failure in response to regional stress.

Of the fifteen formerly producing deposits located on Map ER 86-1-1, eleven, including the San Antonio deposit (Map ER 86-1-1, location RL1), are hosted by massive mafic intrusive and or extrusive rock units, three, including the Ogama-Rockland Mine (Map ER86-1-1, location RL4), are hosted by intrusive quartz diorite and one, the Elora deposit (Map ER 86-1-1, location RL12), is hosted by greywacke.

The San Antonio, Central Manitoba (ER86-1-1, location RL 2) and Gunnar (Map ER86-1-1, location RL3) Mines were the most important gold producers in the Rice Lake greenstone belt (see Deposit descriptions RL 1, RL 2 and RL 3). Although mineralization at all three deposits is of the gold-quartz vein type and structurally emplaced along shear and fracture zones the ore deposits occupy essentially stratabound positions within discrete massive stratigraphic rock units of the Rice Lake Group. Ore zones at the San Antonio Mine are primarily hosted by a thick mafic rock unit descibed as a diabase sill (Stockwell, 1938 and Stephenson, 1972). More recently Theyer (1983, 1984a) interpreted the diabase sill to be a sequence of mafic volcanic flows and volcanogenic sedimentary rocks. Theyer has named these rocks the San Antonio Mine unit or SAM unit and has recognized this lithologic sequence outside of the immediate mine area *(Fig. 10)*. Whiting and Sinclair (1986) conducted a detailed petrological and petrochemical investigation of the SAM unit and concurred with Theyer's interpretation. At the Gunnar Mine the ore deposits

are hosted by an intermediate-mafic pillowed volcanic flow sequence (Stockwell and Lord, 1939; Stephenson, 1971). The most productive veins at the Central Manitoba Mine are hosted by either a chert/tuff rock unit or a gabbroic rock unit (Stockwell and Lord, 1939; Stephenson, 1971) High gold values and the stratabound nature of the quartz vein deposits typically within mafic rock units is attributed to the susceptibility of ferromagnesium minerals to hydrothermal alteration.

Structural and petrological evidence suggests that gold-pyrite mineralization commenced during the D_5 deformation period. Continuation of D_5 deformation after vein formation, or renewed movement along veins during the D_6 deformation event, resulted in liberation of gold from primary ore minerals by mechanical granulation; locally this event was synchronous with introduction of telluride minerals. The interval between the last igneous event within the greenstone belt and vein emplacement led Bailes (1969) and Stephenson (1972) to favour a host rock source for the bulk of the vein material.

Although the association of gold mineralization with mafic intrusive and extrusive rocks is prominent throughout the Rice Lake belt, significant gold does occur within sedimentary rock units.

Near Wallace Lake (Map ER86-1-1, location RL21) stratabound disseminated gold-arsenopyrite mineralization at the Gatlan occurrence is within an argillaceous quartz wacke unit (Gaba, 1984; Gaba and Theyer, 1984; Gaba, 1985; Theyer and Gaba, 1986).

In addition, Theyer and Gaba (1986) identified visible gold-quartz vein mineralization for approximately 400 m that is restricted to a feldspathic wacke unit of the Edmunds Lake Formation at Lily Lake (Map ER86-1-1, location RL20). Stratabound gold mineralization has been documented within a similar sedimentary rock sequence approximately 3 km east-northeast of Lily Lake (Theyer and Gaba, 1986).

PAST PRODUCERS

San Antonio Mine

Location: Bissett, on the north shore of Rice Lake.

Map Reference: Map ER86-1-1, location RL1

Description of Deposit:

The property is underlain by volcanic rocks of the Bidou Lake Subgroup, diabase dykes and sills, and quartz-feldspar porphyry dykes (Stockwell, 1938; Davies et al., 1962; McRitchie and Weber, 1971). Gold-bearing quartz veins occur in what has traditionally been interpreted as a diabase sill. Theyer (1983), on the basis of field observations, suggested that the host rocks of the San Antonio Mine may be mafic to felsic volcanic flows and tuffs, and renamed the host rocks the San Antonio Mine unit (SAM) *(Fig. 10)*. Whiting and Sinclair (1986) concurred with Theyer's results in a detailed petrographic and petrochemical study. Poulsen et al. (1986) concluded that unequivocal evidence for either interpretation is presently lacking.

Two types of veins occur within the host rocks: 1) a northeast-striking set called the "16 type" occupy shear zones that crosscut host rocks at high angles; and 2) a northwest-striking set called the "38 type" forms stockworks that are also discordant to the host rocks *(Fig. 9, 11)*.

The "16 type" veins strike 060-075 and dip 60 NW. The veins pinch and swell along strike and down dip, ranging in length from a few metres to 200 m and in width from a few centimetres to 2 m. The veins are commonly zoned, composed of a core of banded quartz and a quartz-

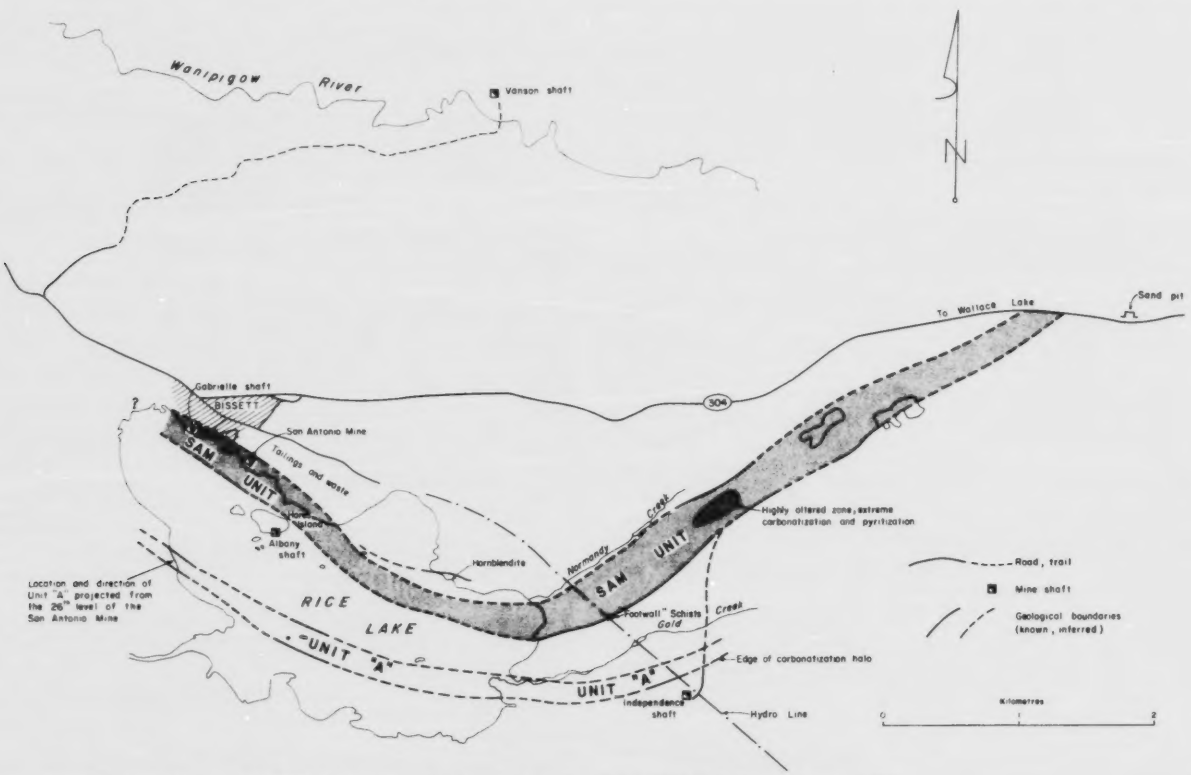


Figure 10. Geological map of the Rice Lake area showing the location of the SAM unit (from Theyer, 1983).

albite-ankerite fringe. Numerous parallel quartz stringers occur in the host rocks on either side of the veins. Pyrite with lesser amounts of chalcopyrite, sphalerite, galena, tellurides and iron oxides form up to 10% of the total vein material. Gold is of widespread but sparse distribution and is associated with fine granular pyrite.

The "38 type" or stockwork veins strike from 300 to 330 and dip vertically or steeply NE. Poulsen et al. (1986) recognized three types of extension veins in the stockworks: 1) stacked or ladder arrangements of sub-parallel horizontal fractures; 2) a set of sub-vertical fractures of variable strike that link and are coeval with the horizontal ones; and 3) a later set of vertical fractures that are normal to the strike of the stockwork as a whole. The core of the stockworks usually consists of angular wall rock fragments enclosed in vein material. The stockwork veins are similar in composition to the "16 type" veins.

Wall rocks adjacent to the "16 and 38 type" veins are fine grained, schistose and have been intensely carbonatized, sericitized, albitized and sulphidized. Gibson and Stockwell (1948) believe that the two vein sets occur in complementary shears resulting from a north-south compressive stress. Poulsen et al. (1986) suggest the 38-type stockwork veins formed in zones of extension between en echelon shears that host the 16-type veins *(Fig. 12)*.

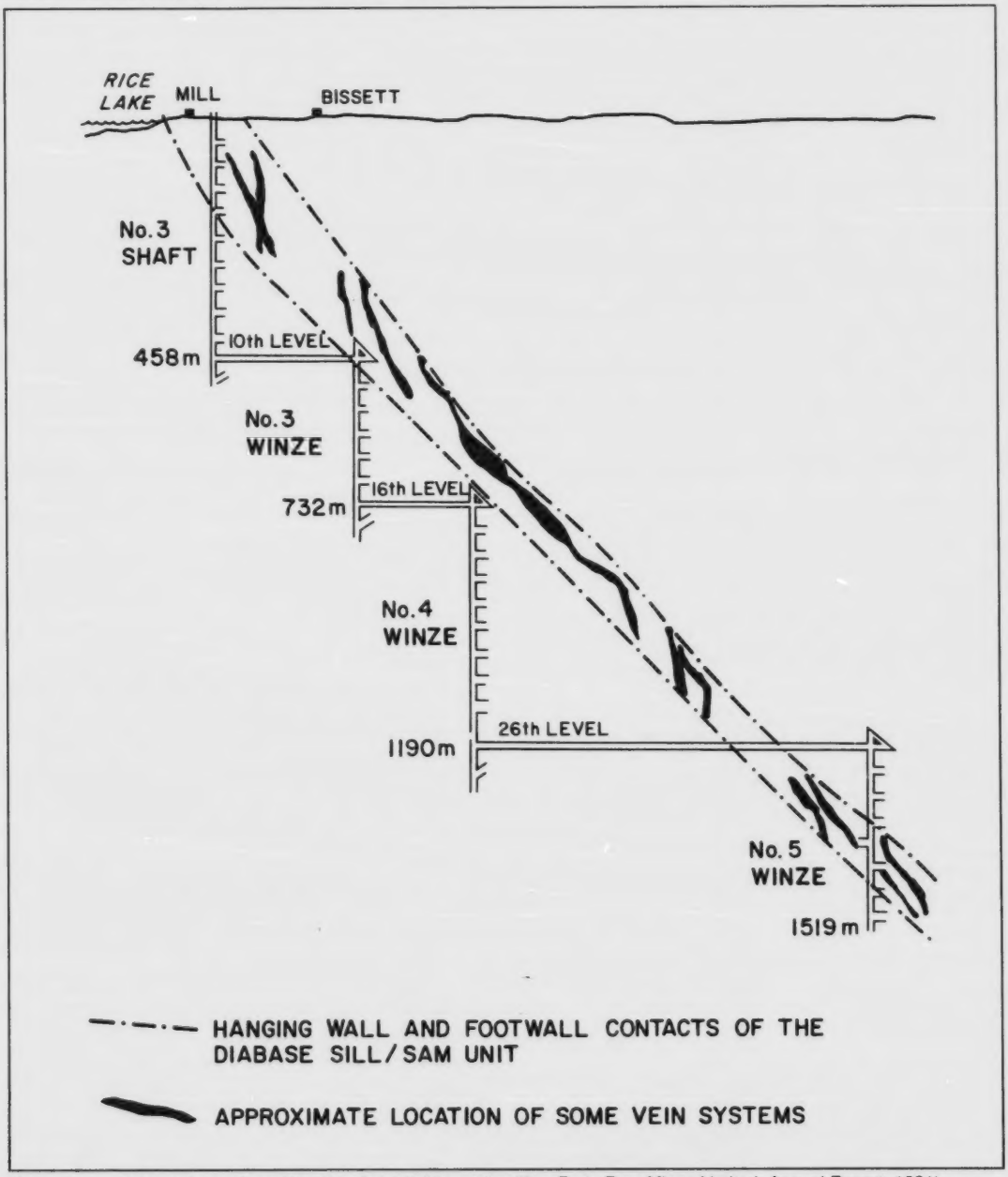


Figure 11. Schematic section of the San Antonio Mine (after New Forty-Four Mines Limited, Annual Report, 1981).

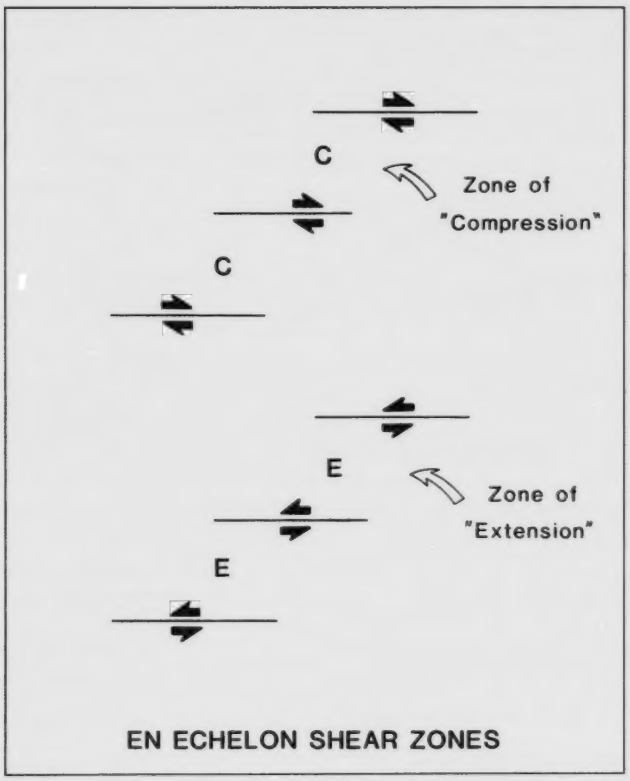


Figure 12. A schematic diagram showing extension zones linking en echelon shear zones (from Poulsen et al., 1986).

History of Exploration and Development:

The San Antonio claim was staked in 1911 by Alex Desautels, who immediately assigned the claim to E.A. Pelletier. Very little development work was done on the claim until 1926 when The Wanipigow Syndicate was formed to explore the property. The syndicate changed its name in 1927 to San Antonio Mines Limited. A second name change occurred in 1931 when the property was refinanced and incorporated as San Antonio Gold Mines Limited. The first gold was produced in 1932 and the mine remained in continuous production from 1932 to 1968. The deposit was developed by a series of three shafts and five winzes to a total vertical depth of 1546 m *(Fig. 11)*.

In 1972 Chemalloy Minerals Limited took out a 60-day option and carried out diamond drilling, limited underground work and ore reserves evaluation. The option was not exercised.

In 1980 Brinco Mining Limited and New Forty-Four Mines Limited entered into a joint venture agreement. Under the terms of the agreement Brinco could earn a 50% interest in the property by conducting a reserves and feasibility study (Northern Miner, August 28, 1980). The 7-month study confirmed mineable reserves of 725 680 tonnes that averaged 6.51 g/tonne (0.19 oz/ton) gold; the mine was re-opened in January 1982. Grades of ore from the upper levels were lower than expected and mining was suspended in May 1983. Exploration, however, was continued in an effort to find the downdip extension of the 97 stockwork vein. It was intersected by nine holes and had an average width of 3.45 m and a grade of 9.26 g/tonne (0.27 oz/ton) gold.

In 1983 Lathwell Resources Ltd. negotiated an option agreement and completed exploration that was designed to test the potential and cost of preparing the 33 and 34 levels for underground drifting and crosscutting. Lathwell estimated ore reserves between the 26 and 36 levels to be 1 203 161 tonnes averaging 7.89 g/tonne (0.23 oz/ton) gold (Northern Miner, September 20, 1984). The option was dropped in late 1984.

In November 1985 the property was optioned by San Antonio Resources, a company jointly owned by Inco Ltd., Quest Resources and private investors. A 6640 m underground diamond drill program was carried out that defined a "mineral resource" of 13 063 kg (420 000 oz.) gold (Northern Miner, September 1, 1986, p. 2).

Figure 13. Aerial view of infrastructure at the San Antonio Mine, Bissett, Manitoba.

History of Production:

Year	Gold produced kg (oz.)
1932-1968	41 519 (1 334 892)
1982 (estimate with 90% recovery)	344 (11 050)
1983 (estimate with 90% recovery)	137 (4 393)
Total	42 000 (1 350 335)

Source: 1932-1968 San Antonio Gold Mines, production cards; 1982-1983 Manitoba Energy and Mines, Mineral Policy.

Selected Bibliography: Davies (1950); Davies et al. (1962); Financial Post Survey of Mines (1969, p. 195); Manitoba Mines Branch, Annual Report on Mines and Minerals (1929-53); Manitoba Energy and Mines, Annual Reports (1982-83), Corporation File (Gabrielle Gold Mines Limited, San Antonio Gold Mines Limited, Scarab Mines Limited), Mineral Inventory File (52 M/4SE Au3); McRitchie and Weber (1971); Robinson (1935); Staff of San Antonio Mine, The San Antonio Mine and Mill; Stephenson (1971); Stockwell (1938, 1945); Stewart (1980); Theyer (1983); Wright (1932).

Central Manitoba

Location: 27 km southeast of Bissett.

Map Reference: Map ER86-1-1, location RL2.

Description of Deposit:

A series of ten gold-bearing veins occur within en echelon shear zones *(Fig. 14)*. Five of these veins produced most of the gold: Kitchener, Eclipse, No. 1 Branch, Tene 6 and Hope. The veins occur within the Wadhope gabbro-diorite sill or a narrow arkose, tuff and chert unit.

In the western part of the property the Kitchener, Eclipse and No. 1 Branch veins occur within tuff and chert beds that range in thickness from 6.1 to 30.5 m. The chert is thinly bedded and green-grey to black. Interlayered with it are grey siliceous rocks composed of fragments of quartz and feldspar in a siliceous matrix. Stephenson (1972) interpreted these rocks to be metagreywackes. The largest tonnages and best grades of ore were located in "bay-like projections of the chert bed into the gabbro" (Wright, 1932). The quartz veins are smoky grey and range from coarse to fine grained. The quartz carries disseminated grains and veinlets of pyrite, chalcopyrite and pyrrhotite. Gold occurs as very fine grained particles.

The Tene 6 vein occurs in the central part of the property within the gabbroic portion of the sill. The deposit is lenticular, up to 7.6 m wide, 61 m long, and consists of dark quartz and considerable pyrite, pyrrhotite and chalcopyrite.

The Hope vein consists of narrow parallel veins and stringers of quartz within sheared diorite. Chalcopyrite, pyrite and free gold are present in the quartz.

History of Exploration and Development:

In 1915 a number of claims were staked over several quartz veins in the area. Diamond drilling and development work outlined two orebodies, the Kitchener vein and the Tene No. 6 vein. Later discoveries were made on the Eclipse, Branch No. 1 and Hope veins. In 1926 Central Manitoba Mines, Limited acquired all property in the area, except the western portion of the Tene No. 6 vein, which was controlled by Manitowan Exploration Company Limited. A 136 tonne cyanidation mill was built and the Central Manitoba Mine went into production in October 1927. The Kitchener, Eclipse and No. 1 Branch veins were developed by 3 shafts to a maximum depth of 266 m. Production from these veins continued until July 1937. A review of the development work from surface to the deepest levels indicated a progressive decrease in the gold content.

The Tene 6 vein was in production from 1932 to 1934. According to Stockwell and Lord (1939) the shaft was sunk to a depth of 107 m with levels at 18, 43, and 76 m.

The Hope vein was developed by a 3-compartment 127 m deep vertical shaft.

The property was inactive from 1935 to 1945. In 1946 the Kitchener, Growler and 48 other leased claims were assigned to New Manitoba Gold Mines Limited who carried out a 12-hole drill program.

From 1947 to 1977 the properties were held by various individuals and companies, but was not explored in any detail.

In 1977 J. Calverley staked the property and carried out trenching and sampling. Ownership was transferred to F. Calverley in 1979 and the claims converted to a production lease.

The ground around the lease is held by Barrick Resources Corporation under option from Mid-North Resources Limited. In the winter and spring of 1981 a geophysical survey was carried out and followed up by a summer-fall program of geological mapping and geochemistry. In 1982 a study was carried out to establish the feasibility of hauling and custom milling surface material from the Kitchener to the San Antonio Mine. In total 437 tonnes of material was hauled and custom milled. Data on gold recoveries are not available. Later in 1984 Angela Development Limited and Arbor Resources Inc. entered into an option agreement with Barrick Resources. During the period August to October 1984, a 10 hole drilling program was carried out.

History of Production:

Year	Ore milled (tonnes)	Grade g/tonne	(oz/ton)	Gold produced kg (oz.) gold	
1928	12 857	15.43	(0.45)	128	(4119)
1929	47 767	17.45	(0.51)	793	(25 482)
1931	41 492	15.97	(0.47)	630	(20 271)
1932	41 789	16.39	(0.48)	652	(20 951)
1933	44 863	14.64	(0.43)	625	(20 099)
1934	43 170	9.35	(0.27)	378	(12 146)
1935	38 830	10.07	(0.29)	363	(11 659)
1936	36 212	12.25	(0.36)	392	(12 596)
1937	27 773	11.05	(0.32)	301	(9670)
1938	13 048	1.54	(0.045)	16	(529)
				9	(295)
Total		347	801	4287	(137 817)

Source: Central Manitoba Mines Limited, annual reports, 1928-1938 (Gold produced from muck hauled to Bissett in 1982 is included in the San Antonio Mine production statistics).

Selected Bibliography: Canadian Mines Handbook (1962, p.152); Manitoba Mines Branch, Annual Reports on Mines and Minerals (1929-1937), Corporation File (Central Manitoba Mines Limited, New Manitoba Gold Mines Limited), Mineral Inventory File (52 L/14 Au10-14); Mines Branch, Ottawa (1929), Investigations in Ore Dressing and Metallurgy (Report 720, p. 127-139, No. 339); Robinson (1935); Russell (1952); Stephenson (1971), Stockwell and Lord (1939); Wright (1932).

Gunnar

Location: 35 km southeast of Bissett.

Map Reference: Map ER86-1-1, location RL3.

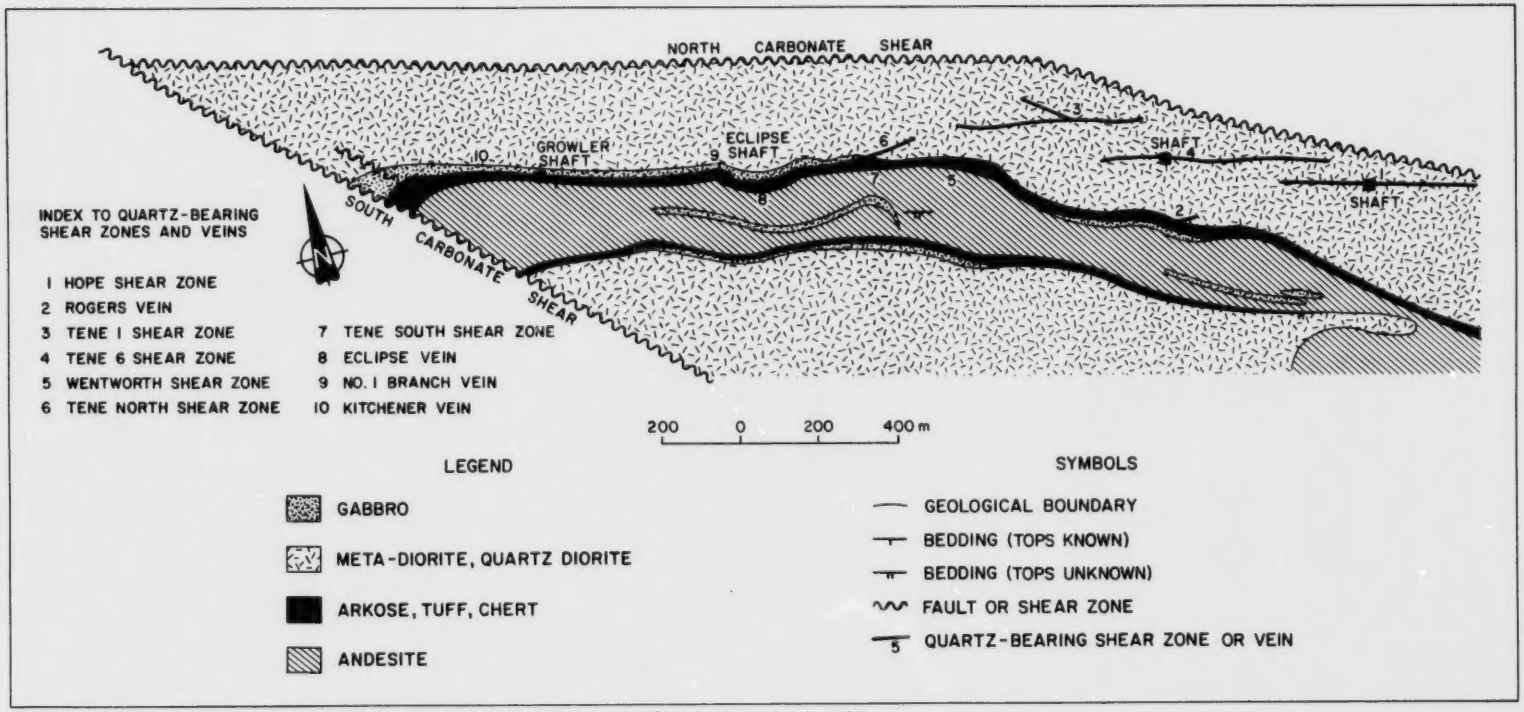


Figure 14. General geology in the area of the Central Manitoba Mine (after Stockwell and Lord, 1939).

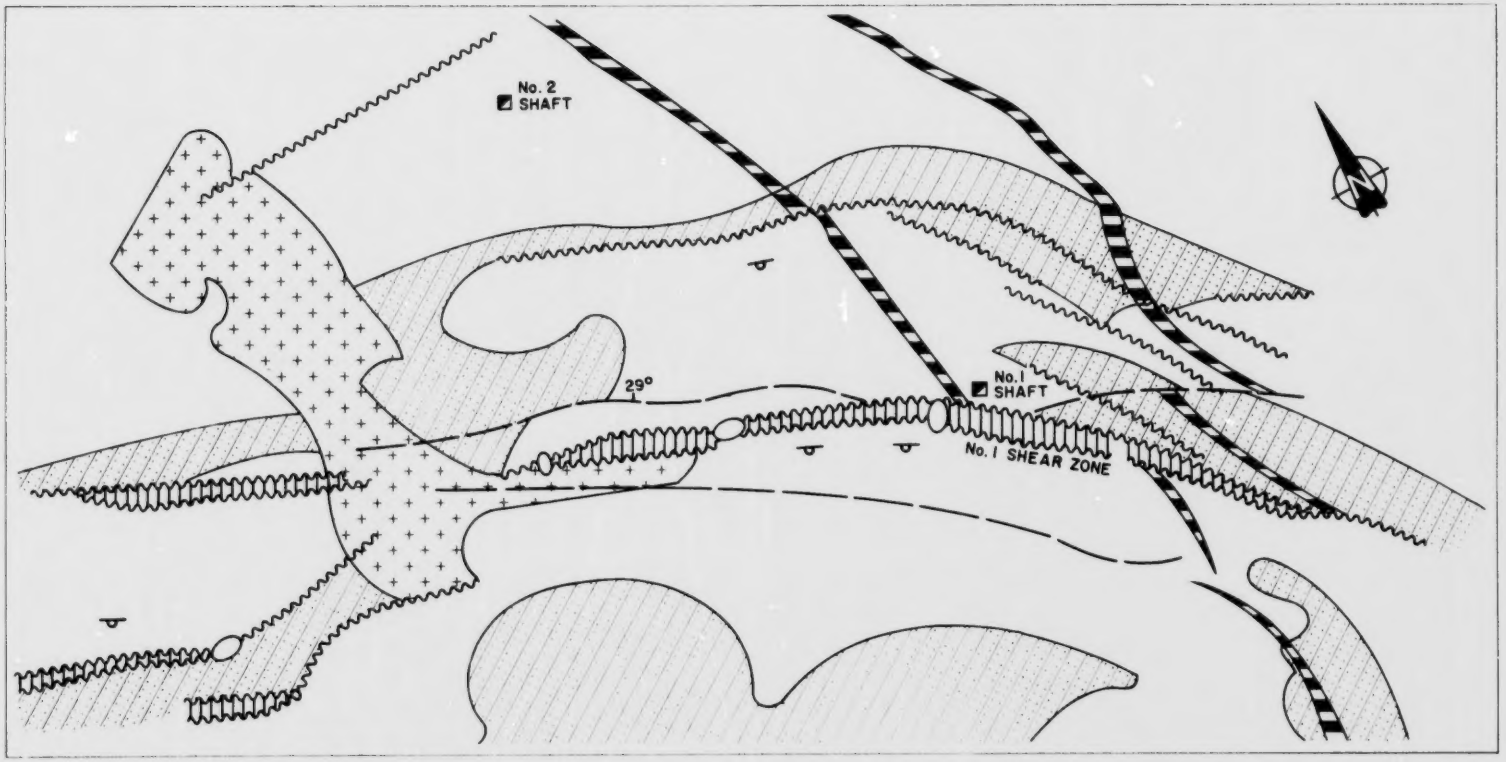


Figure 15. General geology in the area of the Gunnar Mine (after Stockwell and Lord, 1939).

Figure 16. Gunnar Mine site, Beresford Lake, Manitoba.

Description of Deposits:

Six sub-parallel shears striking 070 -075 and dipping 75-90 SE cut pillowed and massive andesites, basalts, feldspar porphyry and lamprophyre dykes, and small granite plugs (Fig. 15). The No. 1 shear zone contains two gold-bearing quartz bodies; each consists of quartz lenses, quartz lenses enclosing wall rock fragments, and quartz stockworks. Three varieties of quartz are present: 1) mottled or streaked grey sugary quartz; 2) transverse veinlets of glassy and cherty quartz; and 3) milky white quartz. Mineralization consists predominantly of pyrite and chalcopyrite with minor sphalerite, galena and marcasite. The gold occurs as irregular grains and stringers; associated with concentrations of finely granulated sulphides in grey cherty quartz (Stephenson, 1972). Dark brown to black varieties of sphalerite are apparently associated with high gold values.

History of Exploration and Development:

In 1921 a gold occurrence was discovered near the south end of Beresford Lake. Gunnar Gold Mines Limited was formed to explore the area and after considerable diamond drilling two shafts were sunk. In 1936 a 136 tonne/day cyanidation mill was built and production began. During the life of the mine drifting and over 22 000 m of diamond drilling was carried out to find new reserves. In 1942, however, reserves were depleted and mining operations stopped. The Gunnar Fraction and Laird claims remained inactive until 1956 when the leases lapsed.

F. Calverley staked the deposit several times from 1957 to 1984. The area was covered by a production lease from 1976 to 1983. Cen Can Ore Recovery Limited gained control of the lease in 1979 with the objective of processing Gunnar mine tailings. The only production figures recorded were for mid-1979 when 363 tonnes were processed to recover 62.2 g (2.0 oz.) of gold. Esso Resources Canada Limited carried out geological mapping, channel sampling and geophysical surveys in the area in 1980 and 1981. In 1984 Highmark Resources Limited and Homestead Resources Ltd. acquired control of the property and undertook a program of tailings sampling, geophysics, soil sampling and prospecting.

History of Production:

Year	Tonnes Milled	Gold production kg (oz.)
1936	46 024	513.1 (16 496)
1937	47 162	592.5 (19 049)
1938	44 480	588.3 (18 915)
1939	46 698	549.9 (17 681)
1940	45 211	521.1 (16 753)
1941	30 107	336.5 (10 819)
1979	363	0.1 (2)
Total	260 045	3101.5 (99 715)

Selected Bibliography: Campbell (1971); Canadian Mines Handbook (1936-1943); Davies et al. (1962); Manitoba Mines Branch, Annual Reports on Mines and Minerals (1935-41), Corporation Files (Esso Resources Canada Limited, Gunnar Gold Mines Limited, Highmark Resources Limited), Mineral Inventory File (52 L/14 Au2); Russell (1952); Shepherd (1939); Stephenson (1972); Stockwell and Lord (1939); Wright (1932).

Ogama-Rockland

Location: 26.6 km southeast of Bissett, 1.6 km north of the east end of Long Lake.

Map Reference: Map ER86-1-1, location RL4.

Description of Deposit:

Two shear zones, the Ogama and Rockland, occur within oligoclase-quartz diorite of the Ross River Pluton. Within these shears the diorite is altered to quartz-sericite schist and contains lenticular gold-bearing quartz veins and veinlets of brown and pink ankerite.

The Ogama shear is at least 245 m long, 0.6 to 1.5 m wide, strikes 313 and dips 82 NE. It contains lenses of blue and white quartz with pyrite, chalcopyrite, arsenopyrite, pyrrhotite and sphalerite. The best gold

grades were found where both pyrite and arsenopyrite occur; visible gold is present locally.

The Rockland shear, a branch of the Ogama, is at least 120 m long, 1.8 to 6.0 m wide, strikes 330° and dips 80° NE. It contains a quartz vein, 0.3 to 0.9 m wide, with pyrite, chalcopyrite, arsenopyrite, minor molybdenite and traces of visible gold.

History of Exploration and Development:

In 1915 W. A. Quesnel and W. Walton staked the Ogama and the Rockland claims. Only limited exploration work was done until Gunnar Gold Mines Limited optioned the property in 1941. Surface work outlined a gold deposit 25 m long on the Ogama vein. A 790 m drill program was carried out and in late 1941 a 2-compartment shaft was sunk. In 1942 Ogama-Rockland Gold Mines Limited was formed to bring the property into production. The mine operated from 1948 to 1951 and was developed by two shafts that reached vertical depths of 314 m and 83 m. The original Ogama and Rockland claims were cancelled in 1966.

In 1966 John Calverley restaked the property and assigned the claims to H.T. Leslie. One hole was drilled before the claims lapsed in 1969.

In 1978 the ground was staked by W.B. Dunlop; linecutting and geophysics were carried out in 1979 and 1980. The claims were assigned to Mid-North Resources Limited in January 1981 and subsequently optioned by Camflo Mines Limited who carried out geophysical, mapping and geochemical surveys. In 1982, 68 tonnes of material was hauled to the San Antonio Mine to test the feasibility of custom milling; the grades proved too low to be economic.

The property was idle until 1984 when Angela Development Ltd. and Arbor Resources Inc. optioned the property and carried out a 3-hole drill program. The option was dropped in 1985.

History of Production:

Tonnes milled	Grade g/tonne (oz/ton) gold
126 192	11.2 (0.33)

(Any gold produced from the surface material hauled to Bissett in 1982 is included in the San Antonio Mine production statistics)

Selected Bibliography: Campbell (1971); Manitoba Mines Branch, Annual Report on Mines and Minerals (1941-53); Corporation File (Gunnar Gold Mines Limited, Ogama-Rockland Gold Mines Limited), Mineral Inventory File (52 L/14 Au1), Mining Engineering Files (Ogama Rockland Gold Mines Limited); Russell (1952a); Stephenson (1972); Stockwell (1945a); Stockwell and Lord (1939); Wright (1932)

Jeep

Location: 13.5 km northeast of Bissett, 6.4 km west of Wallace Lake.

Map Reference: Map ER86-1-1, location RL5.

Description of Deposit:

The deposit is located within several shear zones that strike northwest through an "L" shaped intrusion of dioritic to gabbroic composition.

The deposit is characterized by high grade gold-bearing quartz veins and stringers that occur in sheared hornblende diorite. The veins are less than 0.9 m in width, discontinuous and are composed of grey to bluish quartz with disseminations of pyrite, arsenopyrite and gold. The No. 1 vein is exposed for 61 m on surface but pinches out at depth. There is no apparent association between the amount of sulphides in the quartz and the gold content.

History of Exploration and Development:

The property was first staked in 1934. In 1946 San Antonio Gold Mines Limited formed Jeep Gold Mines Limited to develop the property. Diamond drilling and trenching discovered a high grade, low tonnage deposit. A 3-compartment shaft was sunk and the first gold was produced in 1947. During the life of the mine considerable exploration was carried out to increase ore reserves; however, no new reserves were discovered and the deposit was mined out in 1950.

In 1969 Transtide Industries Limited acquired the property. They carried out a geophysical survey and a 4-hole 546 m drill program in 1973. The holes were collared east of the mine shaft and intersected quartz stringers with disseminated sulphides; assay results are not known (Manitoba Energy and Mines, Mines Branch, Non-confidential assessment file 91561). Augusta Gold Mines Limited acquired the property in 1981. From July 1981 to August 1982 prospecting and geophysical surveys were carried out.

History of Production:

Year	Tonnes milled	Grade g/tonne(oz/ton)		Gold produced kg (oz.) gold	
1947	389	19.54	(0.57)	5.7	(182)
1948	7 425	32.57	(0.95)	236.6	(7 607)
1949	5 707	23.32	(0.68)	131.1	(4 216)
1950	2 798	20.06	(0.60)	56.2	(1 805)
Total	16 319			429.7	(13 811)

Source: The Jeep Gold Mine Limited, Annual Reports 1947 1950.

Selected Bibliography: Amukun (1969); Davies et al. (1962); Eakins (1949); Marr (1970); Manitoba Mines Branch, Mineral Inventory File (52 M/3 Au1); McRitchie and Weber (1971); Russell (1948); Stephenson (1972); Theyer (1983).

Diana (Gem Lake)

Location: 51 km southeast of Bissett, 300 m northwest of the west end of Kickley Lake.

Map Reference: Map ER86-1-1, location RL6.

Description of Deposit:

The property is underlain by pillowed andesite and basalt flows and gabbro. A series of shear zones within these rocks contain four gold-bearing vein systems. The shears are up to 1.5 m wide, strike 295° and dip 70-75° NE. The veins are composed of stockworks of calcite stringers, and quartz stringers and veins. Gold occurs predominantly in fractures in quartz and in chlorite streaks within the quartz. Minor amounts of pyrite, chalcopyrite, pyrrhotite and galena are also present in the veins.

The most productive vein system, the No. 2, was mined on the 38 m level and produced 8702 tonnes of high grade ore. A total of 4500 tonnes of lower grade ore was mined from the 76, 114 and 190 m levels.

History of Exploration and Development:

The area was first staked in 1926. In 1932 Gem Lake Mines Limited built a 45-tonne mill and sank a 3-compartment shaft to a depth of 229 m. Mining began in 1928 and continued until 1932 when Gem Lake Mines was liquidated. During this period 16.95 kg (545 oz.) of gold was produced. In 1933 Diana Gold Mines Limited was formed and acquired the property. From 1934 to 1936, 24 799 tonnes of ore were mined to produce 199.79 kg (6423.64 oz.) gold. In 1936 Diana Gold Mines Limited was

liquidated and the property taken over by Consolidated Diana Gold Mines Limited. This company produced 15.83 kg (509 oz.) of gold over a one year period. A 4-hole drill program carried out to test the No. 2 vein at a depth of 305 m failed to add to the mine's ore reserves and mining was discontinued (Manitoba Mines Branch, Corporation File, Consolidated Diana Gold Mines Limited). The original claim group was cancelled in 1959.

Anderson Lake Mines Ltd. acquired the property in 1967 and planned to rework the old mill tailings; however, the project was never carried out.

In 1972 Rock Ore Exploration and Development entered into an agreement with Gigantes Exploration Company and Selco Mining Corporation. The joint venture drilled 3 holes in 1974 and carried out a geophysical survey in 1977. Canhorn Mining Corp. acquired the property in 1986 and in early 1987 optioned it to Mutual Resources, an affiliate of Teck Corp.

History of Production:

Year	Gold produced kg (oz.)		Silver produced kg (oz.)	
1928-1932	16.95	(545)	1.24	(40)
1934-1936	199.79	(6423.64)	11.66	(375)
1937-1938	15.83	(509)	(?)	
1940-1941	3.02	(97)	0.31	(10)
Total	235.59	(7574.64)	13.21	(425)

Selected Bibliography: Brownell (1931); Manitoba Mines Branch, Annual Reports on Mines and Minerals (1929-39), Mineral Inventory File (52 L/11 Au1), Mining Engineering Files (Gem Lake Mines Limited, Consolidated Diana Gold Mines Limited); McRitchie and Weber (1971); Russell (1952b), Wright (1932).

Lotus

Location: 33 km northwest of Bissett, 3 km north of the Wanipigow River.

Map Reference: Map ER86-1-1, location RL7.

Description of Deposit:

The property is underlain by quartz-hornblende gneiss and hornblende-plagioclase gneiss of the Rice Lake Group (McRitchie and Weber 1971, after Map 71-1/4). A shear zone in the gneisses contains a narrow gold-bearing quartz vein that apparently occurs on the nose of an eastward-plunging syncline (Russell, 1949).

Free gold is visible in many parts of the quartz. Pyrite, chalcopyrite and tetradymite are also present.

History of Exploration and Development:

The Ling (33051) and Lotus (33052) claims were staked in 1924 and were optioned in 1926 by individuals representing Bradley Mining Interests. In 1930 a 249 kg ore sample sent to the Ore Dressing and Metallurgical Division laboratories in Ottawa yielded 22.49 g/tonne (0.81 oz/ton) gold (Parsons, 1931a).

In 1935 Manitou Mines, Limited carried out surface exploration work and "outlined ore grade material" over a length of 60 m (Manitoba Mines Branch, Corporation File, Extracts from Prospectus of Manitou Mines, Limited).

Limited exploration programs were undertaken on the property from 1939 to 1976 by F. Baker, O.J. Quesnel, and Strategic Minerals Prospecting Syndicate.

Esso Resources Canada Limited acquired the property in 1978. They carried out mapping and diamond drilling that outlined a deposit with reserves of 18 140 tonnes grading 10.29 g/tonne (0.30 oz/ton) gold (New Forty-Four Mines Limited, Annual Report, 1981). The deposit was brought into production in May 1982, primarily as a supplementary source of mill feed for the San Antonio Mine. Mining was discontinued in August 1982.

The claims were transferred to W.N. Baker in 1984.

History of Production:

Year	Tonnes milled	Grade g/tonne (oz/ton) gold	
1982	8287	4.56	(0.13)

Source: Manitoba Energy and Mines, Mineral Policy, Annual survey of mining operations.

Selected Bibliography: DeLury (1927); Ermanovics (1970); Manitoba Mines Branch, Corporation File (Brinco Mining Limited, Esso Resources Canada Limited, Manitoba Mines Limited, New Forty-Four Mines Limited), Mineral Inventory File (62 P/1 Au3), Mining Engineering File (Bradley Mining Interests), Non-confidential Assessment File (File No. 91222, 91224); McRitchie and Weber (1971); Russell (1949).

Poundmaker (Selkirk, Luleo)

Location: 8.5 km northwest of Bissett.

Map Reference: Map ER86-1-1, location RL8.

Description of Deposit:

The area is underlain by quartz diorite and diabase dykes. Several shear zones, many of which occur in the diabase, contain veins up to 6.1 m wide that consist of white quartz banded with chlorite and granulated pyrite. Traces of visible gold occur associated with pyrite or in fractures in the quartz. Minor fuchsite and coarse ankerite are of widespread occurrence in the veins. The wall rocks consist of carbonatized and pyritized chlorite schist and locally display well developed slickensides that plunge 025 to the northwest (Stephenson, 1972).

History of Exploration and Development:

The Poundmaker was first staked in 1915 and was optioned by The Bellevue Mining Company, Limited in 1917. A stamp mill was erected and a 2-compartment shaft sunk to a depth of 26 m.

From 1921 to 1924 Selkirk Gold Mining Company Incorporated rehabilitated and extended underground workings, and produced 12.4 kg (400 oz.) of gold. Davies (1949) reported gold values of up to 17.11 g/tonne (0.50 oz/ton) on ore milled prior to 1925. Ore from the 99 m and 160 m levels averaged 3.43 g/tonne (0.10 oz/ton), and 14.49 g/tonne (0.42 oz/ton) gold, respectively.

In 1927 Selkirk (Canadian) Mines, Limited acquired the assets of Selkirk Gold Mining Company Incorporated. The mine was dewatered in 1928 and an 8-hole underground drill program was carried out. The company also carried out surface drilling in the Beaver Lake area and reportedly intersected sections of copper and zinc that assayed from $5.95 to $60.96 per tonne (Manitoba Mines Branch, Corporation File, Selkirk Canadian Mines, Limited).

In 1947 Jacobus Mining Corporation Limited carried out a drill program to test a shear zone below the 160 m level. Drill results are summarized as follows:

Hole No.	Width (metres)	Assay g/tonne (oz/ton) gold	
1	2.03	5.49	(0.16)
	0.20	21.94	(0.64)
	0.82	4.11	(0.12)
	0.27	18.52	(0.54)
2	0.61	5.98	(0.18)
	0.61	4.11	(0.12)
	narrow stringers	13.03	(0.38)

The claims were cancelled on December 12, 1942.

The deposit was staked by a number of prospectors and companies from 1942 to 1977; however, only surface trenching and sampling were carried out.

John Calverley staked the property in 1977. In 1980, 15.8 tonnes of muck from a surface stockpile was shipped to Hudson Bay Mining and Smelting Ltd. (HBM&S) in Flin Flon. It yielded 0.9 kg (29.07 oz.) of gold. A further 2093 tonnes averaging 3.22 g/tonne (0.09 oz/ton) was milled in Bissett when Brinco re-opened the San Antonio Mine in 1982.

History of Production:

Year	Gold produced kg (oz.)	
1923	5.7	(183.8)
1924	6.7	(216.0)
1980	0.9	(29.0)
1982	3.8	(122.4)
1983	2.9	(93.9)
Total	20.1	(645.1)

Selected Bibliography: Amukun (1969); Cole (1927); Davies (1949, 1953, 1963); Davies et al. (1962); De Lury (1920, 1927); Ermanovics (1970); Manitoba Mines Branch, Mineral Inventory File (52 M/4 Au4); Marr (1970); McRitchie and Weber (1971); Robinson (1935); Stephenson (1972); Wright (1923, 1940)

Cryderman (Little Pal)

Location: 21.2 km southeast of Bissett, 0.4 km east of Shesheep Lake.

Map Reference: Map, ER86-1-1, location RL9.

Description of Deposit:

The property is underlain by porphyritic and pillowed andesite, and rhyolite with narrow lenticular bands of chert. These rocks are intruded by gabbro and feldspar porphyry dykes. A shear zone occurs in the axial plane of a fold and contains a lenticular quartz vein (Main vein), up to 1.83 m wide, with free gold and tellurides. The gold occurs as coarse particles along fractures in quartz.

History of Exploration and Development:

In 1925 J.R. Cryderman staked the property. In 1926-27 The Mining Corporation of Canada, Limited sank a 79 m shaft and carried out diamond drilling to the west of the shaft.

In 1928 Cryderman Mines, Limited was organized to continue development of the property. Two parallel shear zones were exposed by trenching and stripping. In March 1932 the shaft was dewatered to the first level and a 36-tonne mill and steam hoist erected. Total gold production in 1932 was approximately 11.6 kg (373 oz.) (Manitoba Mines Branch, Corporation File, Cryderman Mines, Limited).

In 1936 Cryderman Gold Mines Limited carried out drilling to test a structure along the Main vein.

In 1958 surface sampling on the "Main vein" indicated a deposit with a length of 80 m grading 19.2 g/tonne (0.56 oz/ton) gold over an average width of 1.0 m. The only other surface sampling carried out was on the Discovery vein; a branch of the Main vein. Assays returned 17.9 g/tonne (0.52 oz/ton) gold over a width of 0.64 m and length of 67 m.

From 1963 to 1981 various companies staked the property; however, limited exploration work was done until Noranda Exploration Company Limited carried out geophysical surveys in 1982. Ownership of the property was then transferred to Mid-North Resources Limited and subsequently to Donald William, John Specht and Evan A. Koblanski. In 1983 Augusta Resources optioned the property and contracted J.W. Campbell to undertake a reconnaissance prospecting program on the claim. In May 1985 the property was transferred back to Mid-North Resources.

History of Production:
1931 to 1932 — $7711.82 worth of gold, or approximately 11.60 kg (373.09 oz.) gold (Manitoba Mines Branch, Annual Report 1932-33).

Selected Bibliography: Canadian Mines Handbook (1935, p. 72); Manitoba Mines Branch, Annual Report on Mines and Minerals (1932-33). Corporation File (Cryderman Gold Mines Limited, Cryderman Mines Limited). Mineral Inventory File (52 L 14 Au4); Stephenson (1972).

Solo-Oro Grande

Location: 34 km southeast of Bissett, 6.4 km east of the former town of Wadhope, 0.4 km west of Beresford Lake.

Map Reference: Map ER86-1-1, location RL10.

Description of Deposit:

The property is underlain by andesite flows and tuffs that are intruded by diorite sills (Stockwell and Lord, 1939). Gold-bearing quartz lenses and stringers are distributed across a part or the full width of a shear zone, called the Oro Grande shear, for a strike length of 76 m. The lenses are up to 0.6 m wide, 7 m in length and contain grey quartz, minor carbonate, scattered flakes of chlorite, and disseminated pyrite, chalcopyrite, sphalerite, pyrrhotite and locally visible gold. The grey quartz is cut at right angles by short gash veinlets of milky white quartz carrying patches of fine grained chlorite, flakes of biotite, and a few blebs of pyrite. The wall rocks are carbonatized chlorite schist and contain disseminated pyrite.

History of Exploration and Development:

The property was first staked in 1919. From 1923 to 1937 several companies worked in the area: Anglo-Canadian Explorers, Limited; Solo Mining Company, Limited; Oro-Grande Mines Limited; The Oro Grande Development Company Limited; and Beresford Lake Mines Limited.

The property was developed by two shafts: 1) the No. 1 shaft, 161 m deep with levels at 38, 76, 114, and 153 m; and 2) the No. 2 shaft, 78 m deep with levels at 38 and 69 m.

Two ore zones were mined from the 69 m level of the No. 1 shaft. The first averaged 23.97 g/tonne (0.70 oz/ton) gold over a width of 1.30 m and a strike length of 49.41 m. The second zone averaged 17.49 g/tonne (0.51 oz/ton) gold over a width of 1.1 m and a strike length of 34 m.

In June 1984 Highmark Resources Ltd. and Homestead Resources Inc. agreed to a 50-50 joint venture to explore four contiguous claims covering the Solo-Oro Grande Mine and Gunnar Mine. They carried out sampling of tailings sites, geophysical surveys and soil sampling.

History of Production:

Year	Gold produced kg (oz.)	
1932	1.5	(49)
1933	1.7	(54)
1938	62.4	(2006)
1939	74.5	(2395)
1940	19.3	(619)
Total	159.4	(5123)

Source: Manitoba Mines Branch, Annual Reports (1932-33, 1938-40).

Selected Bibliography: De Lury (1927); Financial Post Survey of Mines (1928-29); Manitoba Mines Branch, Annual Report on Mines and Minerals (1929, 1932-33, 1938-40), Corporation File (Beresford Lake Mines Limited, Oro-Grande Mines Limited, The Oro Grande Development Company Limited), Mining Engineering File (Beresford Lake Mines Limited, Oro Grande Development Company Limited), Mineral Inventory Files (52 L/14 Au7); McRitchie and Weber (1971); Russell (1952a); Stephenson (1972); Stockwell and Lord (1939); Wright (1938)

Gold Pan and Gold Seal

Location: 7.5 km southeast of Bissett, 1.8 km south of Gold Lake.

Map Reference: Map ER86-1-1, location RL11.

Description of Deposit:

The area is underlain by porphyritic dacite breccia that is intruded by northeast-striking diabase dykes and crosscut by northwest-striking shear zones. The deposit has a "pipe-like" shape and occurs where a shear zone intersects the southeast contact of a diabase dyke (Stephenson, 1972). It contains numerous lenticular quartz veins with pyrite, chalcopyrite, sphalerite, galena and free gold.

History of Exploration and Development:

The Gold Pan and Gold Seal claims were staked over the deposit in 1914 by Angus McDonald and John Wood, respectively. Shafts were sunk on the claims and a mill built. In 1917 the claims were assigned to Gold Pan Mines, Limited who produced 6.6 kg (214 oz.) of gold from 1919 to 1921.

The Lake Superior Metals Company Limited reopened the mine from 1923 to 1924 and produced a total of 840 g (27 oz.) of gold.

The claims were assigned to Pan Preference Mines, Limited in 1945 and the next year an option was given to Gold Pan Mines (1945) Limited who carried out underground sampling, mapping and drilling (36 holes, 3058 m). The property was assigned to S.J. Drache in 1947. The Gold Seal and Gold Pan claims were cancelled in 1962 and 1971, respectively.

The property was restaked on several occasions from 1962 to 1968; however, there is no record of exploration work being carried out. In 1977 J.A. Syme restaked the property and negotiated a joint venture with Corporate Oil and Gas Ltd., Seaforth Mines Ltd., Onaping Mines Ltd. and Musto Explorations Ltd. A 3-hole drilling program was undertaken in August 1980. In 1982 ownership of the claim was transferred to Augusta Gold Mines Limited.

History of Production:

Year	Gold produced kg (oz.)	
1919	3.51	(113)
1921	3.14	(101)
1923	0.72	(23)
1924	0.12	(4)
Total	7.49	(241)

Source: Manitoba Mines Branch, Annual Report (1928)Selected Bibliography: Cooke (1921); Davies (1953); Davies (1963); DeLury (1921, 1927); Dresser (1917); Manitoba Mines Branch, Annual Report on Mines and Minerals (1928), Corporation File (Gold Pan Mines Limited, Pan Preference Mines Limited, Gold Pan Mines 1945 Limited), Mineral Inventory File (52 L/13 Au4).

Elora (Mill Vein)

Location: 26 km southeast of Bissett, 2.4 km southeast of the south end of Halfway Lake.

Map Reference: Map ER86-1-1, location RL12

Description of Deposit:

Gold-bearing quartz lenses occur within a narrow northeast-striking shear zone that crosscuts greywacke of the Dove Lake formation and a felsic porphyry dyke. The quartz lenses are up to 0.31 m wide and contain "pockets" of arsenopyrite, free gold, and minor chalcopyrite and pyrite (Wright, 1938).

History of Exploration and Development:

The property was first staked in 1915. The Kingfisher Mining and Development Company, Limited installed a 2-stamp amalgamation mill on the property and during 1922 produced 3.1 kg (100 oz.) gold.

Kingfisher Gold Mines Limited acquired the property in 1928 and carried out a diamond drill program. Very limited exploration was carried out after this and the claims lapsed in 1973.

The ground was not open for staking from 1973 to 1978. In 1978 W.B. Dunlop staked the property. The claim was transferred to Camflo Mines Ltd. in 1981 and they carried out geophysical and geochemical surveys and mapping. In 1984 the property was acquired by Angela Development Ltd. and Arbor Resources Inc. From August to October 1984 a 10-hole drill program was carried out. Ownership was transferred to Mid-North Resources Limited in November 1985.

History of Production:

Year	Tonnes mined	Tonnes milled	Gold produced kg (oz.)	
1922	181	113	3.1	(100)

Source: Manitoba Mines Branch, Annual Report (1928).

Selected Bibliography: Campbell (1971); Manitoba Mines Branch, Annual Report on Mines and Minerals (1928), Corporation File (Kingfisher Gold Mines Limited), Mineral Inventory File (52 L/14 Au6); Russell (1952a); Stephenson (1972); Stockwell (1945); Stockwell and Lord (1939); Wright (1932).

Onondaga

Location: 26.5 km southeast Bissett, 1.2 km north of the east end of Long Lake.
Map Reference: Map ER86-1-1, location RL13.

Description of Deposit:

Gold-bearing quartz lenses occur in the southeast extension of the Ogama shear, 460 m southeast of the Ogama-Rockland Mine. The shear is 1.8 m wide, strikes 305 , dips 80 NE and crosscuts pillowed basalt of the Gunnar Formation and felsic porphyry dykes. The lenses of quartz average less than 0.15 m wide and are sparsely mineralized with pyrite, chalcopyrite and locally free gold. Ankerite and calcite occur as rims

around the quartz lenses and as stringers that cut the quartz. The chlorite schist wall rock contains disseminated pyrite.

History of Exploration and Development:

The property was first staked in 1915. In 1924 a shaft was sunk to a depth of 31 m; samples taken from the east and west ribs of the shaft yielded from 1.03 g/tonne (0.03 oz/ton) to 89.14 g/tonne (2.60 oz/ton) gold over widths of up to 1.52 m.

In 1933 the property was assigned to Onondaga Gold Mining Company, Limited who formed Wilson Gold Mines Limited to develop the property. From October 1933 to May 1934, 726 tonnes of ore were milled.

In 1949 Ogama-Rockland Gold Mines Limited acquired the property. The shaft was dewatered, the east and west ribs of the shaft were channel sampled at 3.1 m vertical intervals and drift backs were sampled every 0.9 m. Results of this sampling and a 5-hole drill program carried out in 1950 did not encourage the company to carry out further exploration and the claims were allowed to lapse in 1966.

The property was staked by a number of prospectors and companies from 1969 to 1976; however, limited exploration work was carried out.

The ground was staked in November 1978 by W. B. Dunlop. Linecutting and geophysical surveys were undertaken in 1979 and 1980. In 1981 the claims were optioned by Camflo Mines Limited who carried out mapping, and geophysical and geochemical surveys. In 1984 Arbor Resources Inc. and Angela Development Limited optioned the property and carried out a drill program.

History of Production:

Year	Tonnes milled	Gold produced
1933-34	726	?

Source: Manitoba Mines Branch, Annual Report (1933-34)

Selected Bibliography: Campbell (1971); Manitoba Mines Branch, Mineral Inventory File (52 L/14 Au15); Russell (1952a); Stephenson (1972); Stockwell (1945a).

Grand Central (Lakeshore)

Location: 20.5 km northwest of Bissett, on the north shore of Wanipigow Lake.

Map Reference: Map ER86-1-1, location RL14.

Description of Deposit:

Gold-bearing quartz veins occur in sheared quartz diorite of the Wanipigow River Plutonic Complex.

History of Exploration and Development:

The Lakeshore M.C. (44784) was staked by E. Bonus in 1928. Some surface work was done before the property was assigned to The Grand Central Gold Mines Limited in 1929.

In 1932 the Walsh brothers optioned the claim and sank a 2-compartment shaft to a depth of 33 m. A 5-head stamp mill operated in 1933 and produced 0.9 kg (30 oz.) of gold.

In 1982 H.R.N.D. Mining and Milling Co. Ltd. staked the property.

History of Production:

Year	Tonnes milled	Gold produced kg (oz.)	
1933	272	0.93	(30)

Source: Manitoba Mines Branch, Sixth Annual Report, 1934.

Selected Bibliography: Davies (1949); De Lury (1920); Manitoba Mines Branch, Corporation File (The Grand Central Mines Limited), Mineral Inventory File (52 M/4 Au4); McRitchie and Weber (1971), Parsons (1930).

GOLD DEPOSITS

Packsack

Location: 4 km southwest of Bissett.

Map Reference: Map ER86-1-1, location RL15.

Description of Deposit:

Lenticular en echelon quartz stringers and veins up to 15 m wide occur in shear zones within porphyritic dacite of the Gem Lake Formation. Five of the veins are gold-bearing and consist of milky white to black quartz with pyrite, minor chalcopyrite, and locally visible gold. The gold is erratically distributed and generally occurs in fractures in quartz or associated with pyrite disseminations.

History of Exploration and Development:

The property was first staked in 1917. In 1928 Montcalm-Tine Mines Ltd. was formed to develop the property. The quartz veins were extensively sampled and assay results indicated several zones grading in excess of 31 g/tonne (0.9 oz/ton) gold over short strike lengths. The property was acquired by Consolidated Goldfields of Manitoba in 1933 and subsequently sold to Packsack Mines Limited in 1935. Packsack Mines drilled the "Big Dome" vein and sank a 2-compartment shaft. They estimated probable ore reserves to total 21 800 tonnes averaging 12.36 g/tonne (0.36 oz/ton) gold (Packsack Mines Limited, Annual Report, 1931).

In 1940 God's Lake Gold Mines Limited carried out drilling and underground development but failed to prove or extend the ore tonnages estimated by Packsack Mines.

The property was held by numerous individuals and companies from 1940 to 1984, including R.J. Jowsey Mining Company Limited, Open End Mines Limited, F. Rylander and Augusta Gold Mines Ltd. Reco Gold Mining Co. Ltd. negotiated an operating agreement on the property in 1984, and in the summers of 1984 and 1985 worked a small open-cut and erected a small mill. The property was idle in 1986.

Selected Bibliography: Davies (1953); Manitoba Mines Branch, Annual Report on Mines and Minerals (1935-38, 1941), Corporation File (Montcalm-Tine Mines Limited, Consolidated Goldfields of Manitoba Limited, Packsack Mines Limited), Mineral Inventory File (52 L/13 Au3), Unpublished Information File (52L/13NE); McRitchie and Weber (1971); Stephenson (1972); Stockwell (1945); Theyer (1983, 1984a).

Wolf Prospect

Location: 3.3 km south of Bissett, 0.8 km east of Red Rice Lake.

Map Reference: Map ER86-1-1, location RL16.

Description of Deposit:

The property is underlain by porphyritic andesite and dacite breccia, trachyte breccia, rhyolite and a small lens of conglomerate. These rocks are intruded by diabase and quartz-feldspar porphyry dykes and crosscut by several steeply dipping northwest- and east-striking shear zones. Gold-bearing quartz veins occur in both sets of shear zones, particularly

where they crosscut competent rocks. The veins are lenticular in shape, ranging in width from narrow stringers to 6.1 m, and consist of white to buff quartz with disseminated pyrite and locally visible gold.

History of Exploration and Development:

The property was first staked in 1917. After several interim assignments of ownership Wolverine Gold Mines, Limited obtained the property in 1920. Assays from shallow exploration pits ranged from 11.7 g/tonne (0.34 oz/ton) to 35.3 g/tonne (0.97 oz/ton) gold.

In 1949 Portage Avenue Gold Mines Limited acquired the property and in the following ten years drilled 47 holes; no significant mineralization was intersected. In 1981 Dearin Geological Consulting Ltd. was contracted to carry out mapping, prospecting and drilling. The exploration program indicated five small deposits (New Forty-Four Mines Limited, Annual Report, 1981). Following are the drill indicated reserve estimates:

Vein	Category	Tonnes	Grade g/tonne (oz/ton) gold
Fox	Possible	14 035	6.86 (0.20)
West Fox	Possible	5 990	16.80 (0.49)
Prime	Possible	3 021	25.71 (0.75)

Selected Bibliography: Cooke (1921); Davies (1953); Davies et al. (1962); DeLury (1921,1927); Dresser (1917); Manitoba Mines Branch, Annual Reports on Mines and Minerals (1950-52), Corporation File (Portage Avenue Gold Mines Limited, Wolverine Gold Mines Limited), Mineral Inventory File (52 L/13 Au5); McRitchie, and Weber (1972); Stephenson (1972); Theyer (1984a); Wright (1923).

Ranger

Location: 4.5 km southeast of Bissett.

Map Reference: Map ER86-1-1, location RL17.

Description of Deposit:

Gold-bearing quartz veins and lenses occur in steeply dipping northwest-striking shears that crosscut rhyolite, trachyte and porphyritic andesite of the Gem Lake Subgroup. The stringers and veins range in width from 2 cm to 0.46 m, locally forming lenses up to 4.6 m wide. They contain irregular patches of chlorite, carbonate, disseminated pyrite and rare visible gold.

History of Exploration and Development:

The property was first staked in 1912. After a series of interim assignments Manitoba Mining and Exploration Company, Limited acquired the claim in 1916. Shaft sinking and some trenching was done in 1914. In 1934 Ranger Gold Mines Limited carried out drilling that apparently intersected a "spectacular showing of free gold"; however, "it could not be traced" (Manitoba Mines Branch, Corporation Files, Ranger Gold Mines Limited NPL). To the southeast of the shaft Stockwell (1938) reported that mineralization averaged 13.72 g/tonne (0.4 oz/ton) gold over a width of 1.07 m and a strike length of 27.5 m.

Portage Avenue Gold Mines Ltd. acquired the property in 1949. They estimated the possible reserves of the Ranger deposit to total 1787 tonnes averaging 13.7 g/tonne (0.40 oz/ton) gold (New Forty-Four Mines Limited, Annual Report, 1981).

Selected Bibliography: Canadian Mines Handbook (1935-37, 1946); Cooke (1921); Davies et al. (1962); DeLury (1921, 1927); Manitoba Mines Branch, Annual Report on Mines and Minerals (1933), Corporation File (Ranger Gold Mines Limited), Mineral Inventory Files (52 L/13 Au6); McRitchie and Weber (1972); Stephenson (1972); Stockwell (1938); Theyer (1983), Wright (1923).

Wingold

Location: Bissett.

Map Reference: Map 86-1-1, location RL18.

Description of Deposit:

The property is underlain by dacite to rhyodacite tuffs that are crosscut by several northeast- to east-striking shear zones. The shears host eight gold-bearing veins that consist of two phases of quartz: 1) an early high temperature phase containing tourmaline; and 2) a later phase containing carbonate (Stephenson, 1972). Also associated with the quartz are chlorite, pyrite and locally visible gold.

History of Exploration and Development:

The property is located northeast of the San Antonio Mine. The first claims were staked over the property in 1912. Between 1913 and 1915 five shallow shafts were sunk on the property.

Wingold Mines Limited acquired the property in 1931. Exploration outlined a deposit with reserves of 6535 tonnes grading 13.95 g/tonne (0.407 oz/ton) gold, plus 6349 tonnes in a surface dump grading 7.20 g/tonne (0.21 oz/ton) (Shepherd, 1935). In 1936 a 24-hole 2532 m diamond drill program was carried out.

In 1975 Explored Area Leases 32 and 33 were issued to Greenwood Bolin Dixon to cover the Wingold property. New Forty-Four Mines acquired the property in 1981.

Selected Bibliography: Amukun (1969); Davies (1950); Davies (1963); Davies et al. (1962); De Lury (1920, 1927); Ermanovics (1970); Manitoba Mines Branch, Annual Reports on Mines and Minerals (1934-36, 1938-41, 1944), Corporation File (Forty-Four Mines Ltd., Independence Mining and Development, Wingold Mines Limited), Mineral Inventory File (52 M/4 Au15); McRitchie and Weber (1971); Shepherd (1935); Stephenson (1972); Stockwell (1938); Wright (1923).

Eva

Location: 6.5 km west of Bissett.

Map Reference: Map 86-1-2, location RL19.

Description of Deposit:

The deposit consists of a gold-bearing quartz vein that occurs in sheared quartz diorite. The vein averages 0.9 m wide, has been traced for 244 m on surface and is composed of a greyish-black ribbon-textured quartz with disseminated pyrite, chalcopyrite, sphalerite, magnetite and visible gold. Minor amounts of ankerite, chlorite, sericite and tourmaline are also present.

History of Exploration and Development:

The property was first staked in 1919. The Great West Gold Mining Company, Limited acquired the property in 1921 and sank a shaft to a depth of 18 m.

Various prospectors including Murray, Perry, Harper, Boulette and Henrickson staked the property from 1945 to 1981. Surface exploration continued during this period; however, no further shaft sinking or diamond drilling was reported.

New Forty-Four Mines Limited estimated the Eva deposit to contain mineable reserves of 15 964 tonnes grading 6.17 g/tonne (0.18 oz/ton) gold (New Forty-Four Mines Limited, Annual Report, 1981).

Selected Bibliography: Davies (1949); De Lury (1920); Manitoba Mines Branch, Corporation File (Great West Gold Mining Company, Limited), Mineral Inventory File (52 M/4 Au8); Stephenson (1972).

STEVENSON LAKE-BIGSTONE LAKE-ISLAND LAKE GREENSTONE BELTS

REGIONAL GEOLOGY

Introduction

The Stevenson Lake-Island Lake-Bigstone Lake area is underlain by narrow northeasterly to southeasterly trending linear volcano-sedimentary greenstone belts that extend from Lebrix Lake in the west to the east end of Sagawitchewan Bay of Island Lake and terminate in Ontario to the north of Cocos Lake (Map ER86-1-2, in pocket). Hayes River Group volcanic and sedimentary rocks are overlain by ultramafic to felsic volcanic rocks and Island Lake Group sedimentary rocks *(Table 3)*. Intrusive rocks consist of: Early Plutonic tonalite and granodiorite batholiths that intrude Hayes River Group rocks, granite plutons of the Late Plutonic complex, and mafic to felsic dykes.

Turek et al. (1986) carried out the first precise age determinations for this area. U-Pb zircon ages indicate that all or part of the Hayes River Group is older than 2886 Ma. Early and Late plutonic rocks were dated at 2765 and 2729 Ma, respectively, and represent the lower and upper age limits for deposition of the Island Lake Group.

Hayes River Group

Hayes River Group rocks contain a basal unit up to 2 km thick consisting of: massive and pillowed mafic flows, related gabbro sills, interstratified tuffs, and local chert and greywacke. Occurring within and overlying this unit are: intermediate to felsic tuffs, porphyritic flows and sills, flow breccias and pyroclastic flows. The volcanic rocks are overlain by a sedimentary sequence consisting of: mafic to felsic wackes, siltstones, pebbly siltstones, argillites, polymictic conglomerates, quartz pebble conglomerate, chert and iron formation. The sedimentary rocks are commonly well layered and locally graded.

Early Plutonic Rocks

The greenstone belts are intruded by isolated plutons of tonalite and granodiorite. More extensive areas of granitic rocks surround the belts.

Post-Hayes River Group Ultramafic to Felsic Volcanic and Related Intrusive Rocks

A sequence of rocks comprising ultramafic to mafic differentiated sills, spinifex textured ultramafic rocks, gabbro dykes, felsic volcanic rocks and related sedimentary rocks, occur at a stratigraphic position that correlates with the contact between the Hayes River Group and Island Lake Group *(Fig. 17)*. There is some debate about when the ultramafic rocks were emplaced. Weber et al. (1982) proposed that the extrusive ultramafic rocks were extruded after deposition of the Hayes River Group but before deposition of the Island Lake Group. Theyer (1978), however, proposed that the ultramafic extrusive and intrusive rocks are younger, emplaced within sedimentary rocks at the base of the Island Lake Group.

Island Lake Group

The Island Lake Group unconformably overlies the Hayes River Group rocks and Early Plutonic rocks and is composed of: basal regolith, fluvial quartz wacke and cobble/boulder conglomerate overlain by turbidity current deposits of feldspar lithic wacke grading to argillite and rhythmically layered argillite and siltstone (Weber et al., 1982).

TABLE 3
GENERAL STRATIGRAPHY OF THE STEVENSON LAKE-BIGSTONE LAKE-ISLAND LAKE GREENSTONE BELTS
(after Weber et al., 1982)

Post-tectonic Intrusive Rocks	— granite
Late Plutonic Rocks	— tonalite, quartz diorite, felsic to mafic dykes
.....	Intrusive contact .....
Island Lake Group	— turbidity current deposits of feldspar lithic wacke grading to argillite, rhythmically layered argillite, and siltstone — fluvial deposits of quartz wacke, cobble boulder conglomerate — regolith, wacke
.....	Unconformity .....
Ultramafic to Felsic Volcanic and Related Intrusive Rocks	— felsic volcanic and related sedimentary rocks — ultramafic lenses, spinifex textured ultramafic rocks, ultramafic to mafic differentiated sills
Early Plutonic Rocks	— tonalite, granodiorite
.....	Intrusive Contact .....
Hayes River Group	— sedimentary succession composed of conglomerate, wacke, siltstone, argillite, chert, iron formation, felsic to intermediate flows, pyroclastics, related subvolcanic porphyry — felsic to intermediate volcanic rocks: flows, pyroclastics, and related subvolcanic porphyries — mafic to intermediate volcanic rocks: flows, tuffs, breccias and related subvolcanic gabbro sills.

Late Plutonic Rocks

Late Plutonic rocks consist of tonalite, quartz diorite, mafic dykes and plagioclase and quartz phyric dykes. The youngest rocks are post-tectonic granites.

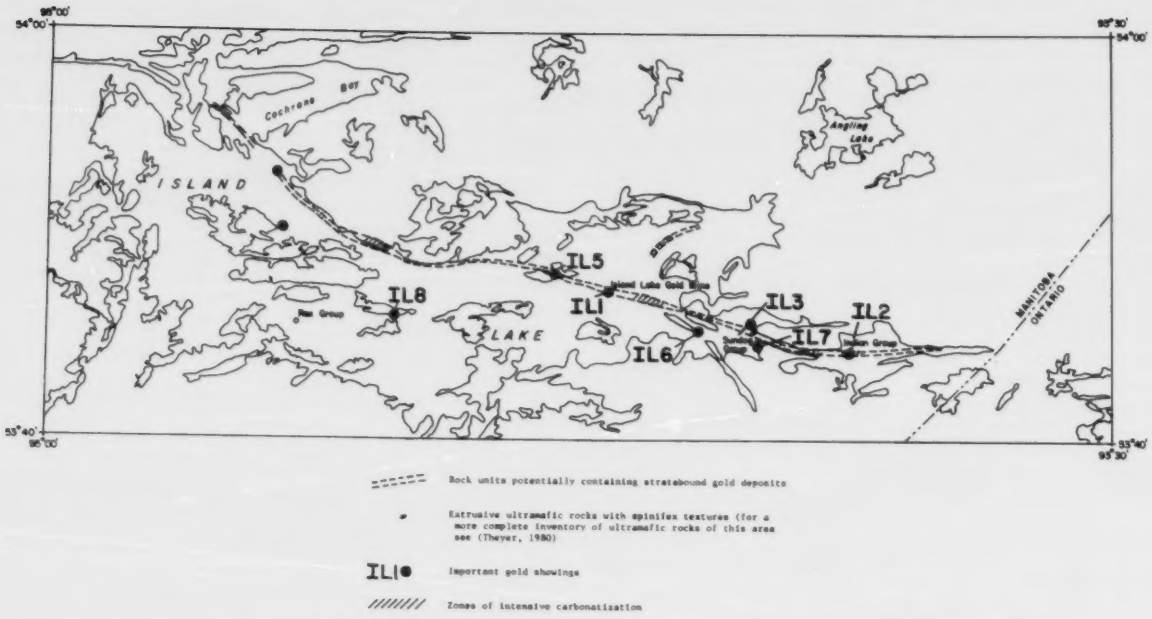


Figure 17. Approximate location of the contact between Hayes River Group and Island Lake Group rocks (after Theyer, 1981)

STRUCTURE

Godard (1963), Weber et al. (1982), Neale (1984) and Gilbert (1985a) recognized two phases of folding: 1) F_1 folds produced tightly folded synclinoria that trend west to northwest in the Stevenson Lake and Island Lake areas and northeast in the Bigstone Lake area; and 2) major F_2 folds wrap F_1 folds around northeast- to northwest-trending axes in the Bigstone Lake and eastern Island Lake areas.

Numerous early fault zones are parallel or subparallel to the axial planes of F_1 folds. Strike slip faults produced shear zones characterized by amphibolite schists and sericite schists. Late northeast- to northwest-trending faults cut early structures at high angles displacing them for distances in excess of 10 m.

MINERALIZATION

In the Stevenson Lake-Bigstone Lake-Island Lake area two deposits and sixteen occurrences are located on Map ER86-1-2. The deposits and occurrences can be divided into three groups: 1) those hosted by rocks at the Hayes River Group-Island Lake Group interface (Fig. 17); 2) those associated with extensive areas of silicification in the Hayes River Group rocks (Fig. 18); and 3) narrow discontinuous quartz and carbonate veins filling shear zones.

Gold mineralization hosted by rocks of the Hayes River Group-Island Lake Group interface are: Island Lake Mine (IL1), Indian (IL2), Sundog (IL3), Cowan (IL4) and Savage Island (IL5) (Fig. 17). Theyer (1985) was the first to recognize the association of gold mineralization with the Hayes River Group-Island Lake Group interface and suggested that it was a prime target for gold since: 1) ultramafic rocks that occur along the interface are a potential source of gold; 2) carbonatization of the ultramafic rocks provides a mechanism for liberation of contained gold; 3) intensely sheared rocks in the area of the ultramafic rocks provide favourable sites for deposition of gold and 4) geochemically anomalous concentrations of Au, As, and W were found in samples taken from rock units adjoining areas underlain by ultramafic rocks.

Gold mineralization associated with extensive areas of silicification occurs at the southeast end of Island Lake where a 100-150 m wide silicification halo in Hayes River Group mafic rocks extends from the southeast tip of Okay Island (IL6) to Reahil Island (IL7) in the east *(Fig. 18)*. At the core of the silicification halo is a sulphide-bearing quartz vein that has assayed up to 129.61 g/tonne (3.78 oz/ton) gold (Theyer, 1982).

The remaining occurrences in the area consist of gold and sulphide-bearing quartz-carbonate veins that occur in shear zones. Of these, eight occur in Hayes River Group mafic to felsic volcanic and sedimentary rocks, three occur in quartz veins in Late Plutonic rocks adjacent to volcanic-intrusive contacts (including High Rock Island, IL8) and one occurs in a felsic dyke.

Weber et al. (1982) suggested that a fourth type of mineralization may occur in the area. They felt that conglomerates and crossbedded sandstone of the Island Lake Group may have potential for paleoplacer gold deposits. However, assays of grab samples from these "suspected fluvial" magnetite-bearing sedimentary rocks yielded no detectable gold (Theyer, 1986, pers. comm.).

PAST PRODUCER

Island Lake

Location: 470 km northeast of Winnipeg, 240 km east of Norway House, on Mine Island in the central part of Island Lake.

Map Reference: ER86-1-2, location IL1.

Description of Deposit:

In the mine area rocks of the Hayes River Group-Island Lake Group interface consist of: argillite, black slate and quartzite. These rocks are intruded by quartz porphyry and mafic dykes.

McMurchy (1944) was the first to describe the mineralization in the mine area; the underground workings were inaccessible and many of the

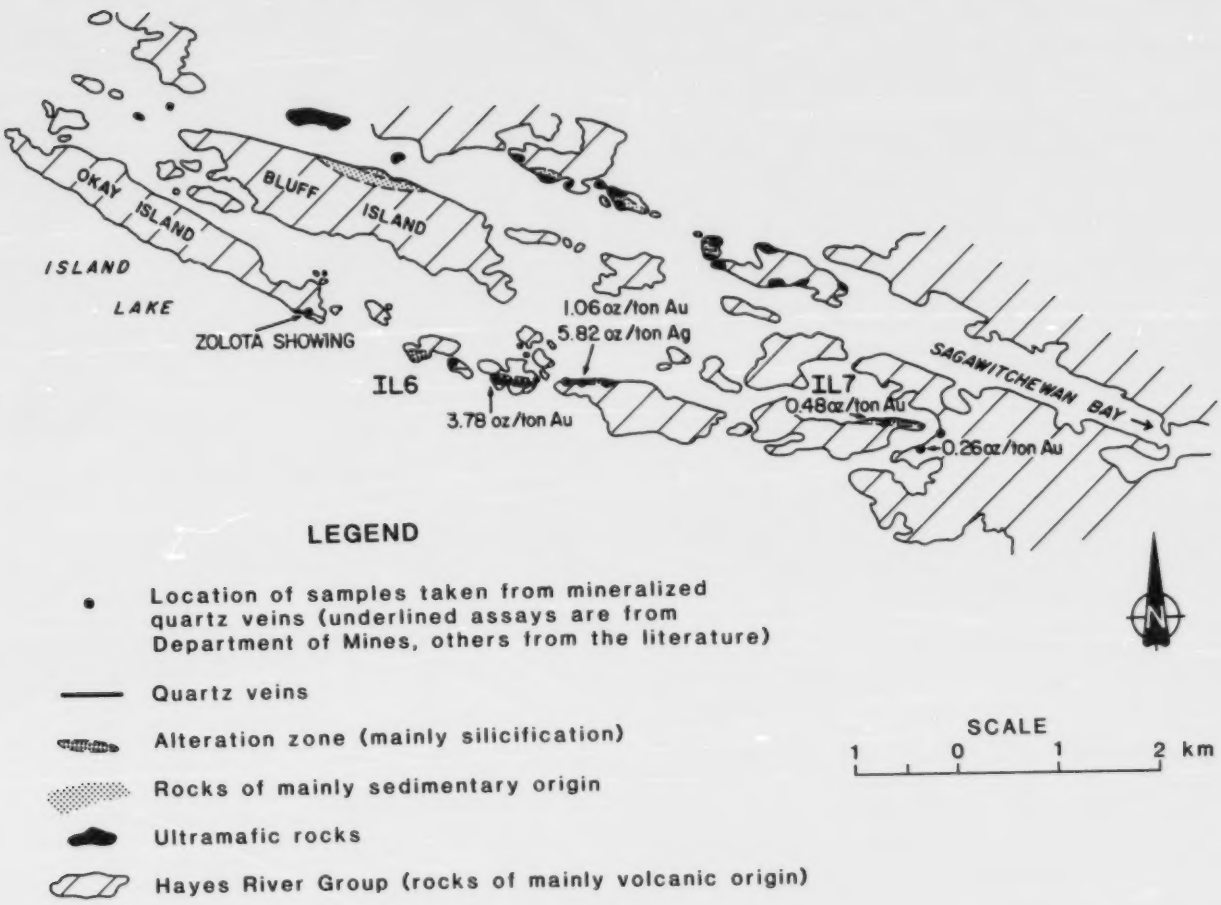


Figure 18. Gold mineralization at the eastern end of Island Lake (after Theyer, 1982).

trenches had collapsed, limiting his mapping to outcrops. He observed several sulphide-bearing quartz veins up to 1.5 m wide, an "area" with numerous lenses and stringers of quartz, and two "large masses" of "sparsely mineralized" quartz. More recently Theyer (1981) mapped the surface geology and described several zones of intense silicification, pyritization and carbonatization. Mineralization consists predominantly of pyrite and pyrrhotite with lesser amounts of galena, arsenopyrite and locally sphalerite *(Fig. 19)*. Muckpiles by the shaft contain some visible gold.

The rocks in the mine area are tightly folded and display a well developed axial planar foliation. Theyer (1981) suggested that the gold may have been concentrated in quartz veins in the hinges of folds.

History of Exploration and Development:

Island Lake Gold Mines, Limited was formed in 1928 to explore a prospect on a group of four islands in east-central Island Lake. In 1931, 31 drill holes intersected mineralization over a strike length of 519 m. Ventures Limited, under option from Island Lake Mines Limited, sank a 2-compartment shaft to a depth of 83 m with levels established at 43 m and 73 m. The mine produced 186.2 kg (5986.6 oz.) of gold from April 1934 to March 1935, before known reserves were depleted. A 5-hole underground drill program was carried out to locate more ore: the results were as follows:

Set Up	Hole No.	Direction	Width	Assay g/tonne (oz/ton) gold
1	1	+45°/N	1.07 m	104.58 (3.05)
	2	+30°/N	1.43 m	36.00 (1.05)
	3	0 /N	1.22 m	8.57 (0.25)
			2.14 m	7.54 (0.22)
2	1	+45°/N	0.76 m	17.14 (0.5)
	2	+30°/N	1.16 m	6.17 (0.18)

(Source: Manitoba Mines Branch Annual Report 1934-1935, p 60-61)

Although the results were encouraging, further work was not carried out.

From 1959 to 1981 the property was staked by a number of individuals including P. Smerchanski, T. Hamilton, R. McKenzie, C. Wass and W. Miller.

In 1981 W.B. Dunlop staked the area and optioned it to BP Canada. BP in joint venture with St. Joe Canada Inc. carried out diamond drilling in 1982, 1983 and 1984. The option was dropped in 1985.

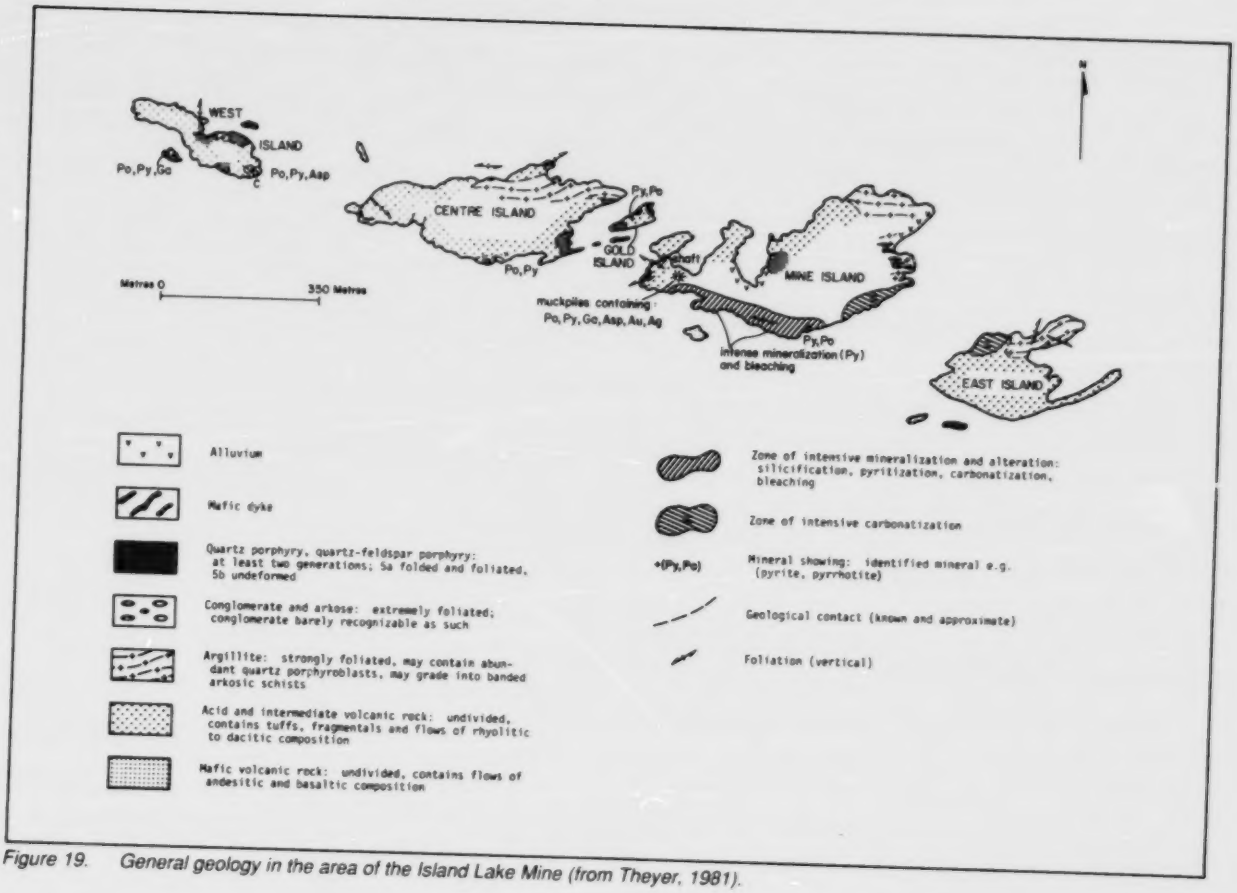

WEST
ISLAND
Po,Py,Go
Po,Py,Asp
CENTRE ISLAND
Py,Po
GOLD ISLAND
Po,Py
shaft
MINE ISLAND
Metres 0
350 Metres
muckpiles containing
Po, Py, Go, Asp, Au, Ag
Py,Po
intense mineralization (Py)
and bleaching
EAST ISLAND
N
Alluvium
Mafic dyke
Quartz porphyry, quartz-feldspar porphyry: at least two generations; 5a folded and foliated, 5b undeformed
Conglomerate and arkose: extremely foliated; conglomerate barely recognizable as such
Argillite: strongly foliated, may contain abundant quartz porphyroblasts, may grade into banded arkosic schists
Acid and intermediate volcanic rock: undivided, contains tuffs, fragmentals and flows of rhyolitic to dacitic composition
Mafic volcanic rock: undivided, contains flows of andesitic and basaltic composition
Zone of intensive mineralization and alteration: silicification, pyritization, carbonatization, bleaching
Zone of intensive carbonatization
+(Py,Po)
Mineral showing: identified mineral e.g. (pyrite, pyrrhotite)
Geological contact (known and approximate)
Foliation (vertical)

Figure 19. General geology in the area of the Island Lake Mine (from Theyer, 1981).

Figure 20. Aerial view of the Island Lake Mine site.

History of Production:

Year	Tonnes milled	Grade g/tonne (oz/ton)	Production kg (oz.) gold	
1934	6336	20.92 (0.61)	133.36	(4287.6)
1935	1483		*52.84	(1699)
Total	7819		186.2	(5986.6)

*estimate based on bullion and concentrate receipts of $59 483 (Manitoba Mines Branch, Annual Report, 1935).

Selected Bibliography: Gilbert (1985a); Godard (1963); Manitoba Mines Branch, Mineral Inventory File (53 E/16 Au1); McMurchy (1944); Theyer (1980, 1981, 1982, 1985); Weber et al. (1982); Wright (1928).

GOLD DEPOSIT

High Rock Island

Location: near the southeast shore of High Rock Island on Island Lake. Map Reference: ER86-1-2, location IL8.

Description of Deposit:

The deposit consists of gold-bearing quartz veins that strike at right angles across the contact between granite and Hayes River Group volcanic rocks. The "Main" vein strikes 355 , dips 85 E and ranges in width from 0.40 to 0.73 m. Mineralization consists of free gold, pyrite, chalcopyrite, galena and tellurides.

History of Exploration and Development:

The property was first staked in 1934 by J. Wass. Later in 1934 Ministik Lake Gold Mines Limited acquired an interest in the property and carried out trenching and sampling. A series of eleven channel samples were taken from a quartz vein for 137 m along strike. The samples assayed 44.23 g/tonne (1.29 oz/ton) gold over an average width of 0.61 m. A 2-compartment shaft was sank to a depth of 72 m with levels established at 38 m and 69 m. Work was discontinued later in 1937. The claims were then allowed to lapse.

Ministik Lake Gold Mines restaked the property in 1950 and carried out a 3-hole 393 m diamond drill program. Assays of vein material ranged from 0.34 g/tonne (0.01 oz/ton) to 1.71 g/tonne (0.05 oz/ton) gold.

A Manitoba Mines Branch field party took grab samples of the vein in 1951 that yielded assays of 74.06 g/tonne (2.16 oz/ton) gold (Godard, 1963, p. 41).

Only limited amounts of exploration were carried out on the property from 1951 to 1978.

R. McKenzie staked the property in 1978. In 1985 Wydmar Resources Enterprises Ltd. and Bighorn Development Corporation each acquired a 20% interest in the property and carried out a 75-hole drill program. Significant intersections are listed below:

Hole	Hole Depth (metres)	Width (metres)	Assay g/tonne (oz/ton) gold	
34	47.28-50.48	3.2	3.43	(0.10)
35	76.56-76.86	0.30	3.77	(0.11)
47	17.69-18.3	0.61	9.26	(0.27)

Source: Northern Miner, April 2, 1986, p. 10.

During the summer of 1986 Bighorn Development carried out extensive sampling of the main vein over a strike length of 175 m. They estimated the deposit to contain a geological inventory of 326 000 tonnes grading 15.43 g/tonne (0.61 oz/ton) gold (Northern Miner, November 3, 1986). Based on these results the company recollared the shaft, rehabilitated the underground workings and carried out further drilling. In 1987 the companies plan to carry out further diamond drilling.

Selected Bibliography: Godard (1963); Manitoba Mines Branch, Corporation File (Ministik Lake Gold Mines Limited), Non-confidential Assessment File (91150); McMurchy (1944).

OXFORD LAKE-KNEE LAKE-GODS LAKE-KISTIGAN LAKE GREENSTONE BELTS

REGIONAL GEOLOGY

Introduction

The Oxford Lake, Knee Lake, Gods Lake and Kistigan Lake areas of Manitoba are underlain by a series of southeasterly trending Archean volcano-sedimentary greenstone belts. The belts extend from the Cotton Lake area of Manitoba to the Big Trout Lake area of Ontario (Map ER86-1-2, in pocket).

Wright (1928) divided the supracrustal rocks of the belts into two groups: 1) the predominantly volcanic rocks of the Hayes River Group; and 2) the overlying predominantly sedimentary rocks of the Oxford Lake Group (Table 4). Plutons and batholiths, collectively called the Bayly Lake Complex, intrude Hayes River Group rocks in the area between Knee Lake and Gods Lake, and along the southern shores of Oxford Lake and Carrot River. The belts are bounded at their margins by extensive granitoid terrains with intrusive phases that predate or postdate Oxford Lake Group rocks (Gilbert, 1985b; Hubregtse, 1985).

Radiometric dates on supracrustal rocks range from 2400 to 2700 Ma. Hansen (in Clark and Cheung, 1977) and Catanzaro (in Hubregtse, 1985) determined an age of 2700 Ma for Hayes River Group rocks in the Knee Lake area. Brooks et al. (1982) determined an age of 2650 80 Ma for volcanic rocks of theOxford Lake Group. The Bayly Lake pluton was dated at 2424 74 Ma, suggesting that it postdates the Oxford Lake Group (Clark and Chueng, 1977). This is not consistent with field evidence that supports a pre-Oxford Lake Group age for the pluton. The post-Oxford Lake Group Magill Lake pluton was dated at 2455 35 Ma (Clarke and Cheung, 1977). Mafic dykes in the Gods Lake area were dated at 1105 Ma (Wanless et al., 1966).

Hayes River Group

The Hayes River Group is composed predominantly of pillowed and massive basalt flows, felsic to intermediate flows, intravolcanic ultramafic to mafic sills and dykes, and narrow sedimentary units of iron formation, chert, greywacke and minor conglomerate. Gilbert (1985b) observed that volcanic rocks exhibit either cyclical mafic to felsic differentiation sequences (Knee Lake) or non-cyclical predominantly mafic sequences (Gods Lake).

Bayly Lake Complex

Emplacement of the Bayly Lake Complex postdates deposition of the Hayes River Group and predates deposition of the Oxford Lake Group. The complex consists of: tonalite, granodiorite, granite and syenite plutons within the greenstone belts; and extensive granitoid terrains that surround the greenstone belts.

Oxford Lake Group

The Oxford Lake Group unconformably overlies the Hayes River Group and the Bayly Lake Complex. It consists of a lower predominantly volcanic stratigraphy and a younger overlying sedimentary rock sequence. The volcanic rocks range in composition from basalt to rhyolite. The sedimentary rocks consist of conglomerate, greywacke, arkose, amphibolite, minor iron formation and minor argillite.

Intrusive Rocks

Oxford Lake Group rocks are intruded by granodioritic and gabbroic plutons, and olivine norite and diabase dykes.

TABLE 4
GENERAL STRATIGRAPHY OF THE OXFORD LAKE-KNEE LAKE-GODS LAKE-KISTIGAN LAKE GREENSTONE BELT

Intrusive Rocks	— diabase, gabbro, olivine norite, granodiorite
— — — — — — intrusive contact — — — — — —	
Oxford Lake Group	— amphibolite, arkose, greywacke, and conglomerate — basalt to rhyolite flows and pyroclastic rocks.
— — — — — — unconformity — — — — — —	
Bayly Lake Complex	— tonalite, granodiorite, granite, — syenite
— — — — — — intrusive contact — — — — — —	
Hayes River Group	— greywacke, minor conglomerate — rhyolite to dacite flows and volcanic fragmentals — minor related sedimentary rocks and iron formation — basalt and andesite, mainly pillowed flows, related gabbro and minor ultramafic rocks.

METAMORPHISM

The majority of rocks have mineral assemblages indicative of metamorphic facies ranging from lower greenschist to middle amphibolite facies; amphibolite facies metamorphism is restricted to narrow highly deformed segments of the greenstone belts (Hubregtse, 1985).

Gilbert (1985b) recognized three metamorphic events in the Knee Lake-Gods Lake area: 1) an M_1 upper greenschist to amphibolite facies metamorphic event predating Bayly Lake Complex and Oxford Lake Group rocks; 2) an M_2 amphibolite facies metamorphic event that postdates deposition of the Oxford Lake Group rocks; and 3) M_3 retrogressive greenschist metamorphism.

STRUCTURE

Gilbert (1985b) recognized five periods of deformation. A D_1 deformation accompanied M_1 metamorphism and is characterized by: 1) a northwest-trending synclinorium (F_1) in the Knee Lake area; 2) east-northeast to east-southeast-trending tight isoclinal folds (F_1) in the Gods Lake area; and 3) east-northeast regional foliation (S_1) parallel to layering in the Munro Lake area. Post-Oxford Lake Group D_2 deformation consisted of: 1) tight steeply plunging isoclinal folds (F_2) with east-northeast

o east-southeast axial traces within Oxford Lake Group rocks and 2) ghtening of earlier formed F_1 folds within Hayes River Group rocks. The D_3 deformation produced tight F_3 folds with moderate to steeply dipping xial planes trending east-northeast to east-southeast, parallel to the F_2 olds. The D_4 deformation produced subhorizontal folds (F_4) with roughly ertical axial planes normal to F_3 folds. The D_5 deformation produced rittle conjugate fractures, faults, en echelon dilation fractures and shear ones parallel to regional foliation. Some shearing parallel to regional oliation preceded D_5 deformation. The majority of D_5 fractures and ssociated dykes and veins are parallel to slightly discordant to regional oliation.

In the Oxford Lake-Carrot River area Hubregtse (1985) did not ecognize any pre-Oxford Lake Group deformational features and inter- preted D_1 deformation to have occurred after deposition of the Oxford Lake Group and to be associated with the M_2 metamorphic event. Hayes River Group monoclines and Oxford Lake Group rocks were folded (F_1) nto west-northwest-trending isoclinal folds and synclinoria. The D_2 deformation produced dextral and sinistral wrench faults trending east to northeast. These faults were postdated by sinistral wrench faults (D_3). In the Eight Mile Point area of Oxford Lake one of these faults produced (F_2) drag folds that locally refolded F_1 folds about an east-trending fold axis.

MINERALIZATION

The two deposits and twelve gold occurrences, located on Map ER86-1-2, are characterized by two styles of mineralization: 1) strata-bound gold-bearing quartz stringers that are generally concordant to bedding and 2) gold-bearing quartz and carbonate-filled shear and fracture zones in quartz-feldspar porphyry intrusions, tuffaceous sediments and mafic volcanic rocks.

At the God's Lake Gold Mine (Map ER86-1-2, GL1) disseminated sulphides and gold-bearing quartz stringers occur in a 3 m thick stratigraphic unit of chemical and detrital sedimentary rocks *(Fig. 21)*. At the Smelter (GL2), Pickle No. 1 and No. 2 (GL3) and Gold Group occurrences (GL4) gold-bearing quartz stringers and veins occupy shear zones in tuffaceous rocks. The stringers and veins are discontinuous, locally forming zones of up to 25% quartz and sulphide.

Gold-bearing quartz veins and quartz-carbonate stringers occur in quartz porphyry and quartz-feldspar porphyry dykes at Jowsey Island (GL5), Knee Lake Gold Mines Limited (GL6), Johnston Knee Lake Mines Limited (GL7), Kistigan Lake (GL8) and Midas 54 (GL9). Shears in mafic volcanic rocks were up to 18.3 m wide and contain narrow discontinuous quartz veins and stringers at Painkiller Bay (GL10), Big Lynx (GL11), LMD (GL12) and Neda (GL13). Mineralization consists predominantly of pyrite or pyrrhotite with lesser to trace amounts of chalcopyrite, sphalerite, galena, arsenopyrite, and locally visible gold.

PAST PRODUCER

Gods Lake

Location: 560 km northeast of Winnipeg, on the northwest shore of Elk Island of Gods Lake.

Map Reference: Map ER86-1-2, location GL1.

Description of Deposit:

The area is underlain by andesite and basalt flows that are intruded by gabbro and quartz-feldspar porphyry dykes and sills *(Fig. 21)*. Gold mineralization occurs within a 3 m thick unit at the contact between a gabbro sill and basalt flows. Baker (1935) described the unit as a "tuff bed" that consists of: 1) very fine grained, black and slaty textured tuffaceous rocks; 2) slightly coarser grained tuffs composed of chlorite and hornblende schist; and 3) coarser grained black, reddish-brown, jade-green, or light pearly grey tuffs locally showing well defined bedding planes. Theyer (1984b) described the unit as fine grained volcanogenic(?) detrital and chemical sedimentary rocks.

Mineralization occurs predominantly within quartz stringers that generally parallel bedding planes. Sulphides are also weakly disseminated throughout the host rocks. Pyrrhotite is the predominant sulphide with lesser amounts of pyrite, arsenopyrite, galena and chalcopyrite. Free gold is found sporadically in the quartz stringers.

History of Exploration and Development:

In 1932 R.J. Jowsey and A. MacDonald made the original discovery in the Gods Lake area at Jowsey Island. On the strength of the original discovery a total of 148 claims were staked and God's Lake Gold Mines Limited[1] was incorporated to develop the claims. Trenching, diamond drilling and underground development outlined a deposit with reserves of 69 000 tonnes grading 14.74 g/tonne (0.43 oz/ton) gold. The mine went into production in 1935. During mine development additional reserves were discovered that extended the life of the mine until 1943; in total 490 866 tonnes of ore were mined to a depth of 267 m *(Fig. 22)*.

The property was transferred to Lingman Lake Gold Mines Limited in 1948. This company changed its name several times and is now called Twin Gold Mines Ltd. Only limited exploration work has been carried out on the property since the mine closed.

History of Production:

Year	Tonnes milled	Gold produced kg (oz.)	
1935	13 616	117.5	(3 779)
1936	49 441	567.0	(18 231)
1937	55 766	553.0	(17 781)
1938	64 155	690.0	(22 183)
1939	65 860	802.9	(25 814)
1940	65 101	644.1	(20 711)
1941	66 130	681.8	(21 922)
1942	66 082	508.6	(16 353)
1943	44 715	425.4	(13 677)
Total	490 866	4990.3	(160 451)

Source: God's Lake Gold Mines Limited, Annual Reports 1935-1947

Selected Bibliography: Baker (1935); Brooks (1982); Clark and Cheung (1977); Hubregtse (1985); Manitoba Mines Branch, Corporation File (God's Lake Gold Mines Limited), Mineral Inventory File (53 L/9NE Au2); Southard (1977); Theyer (1984); Wanless et al. (1966); Wright (1932).

GOLD DEPOSIT

Jowsey Island

Location: 560 km northeast of Winnipeg, Jowsey Island, Gods Lake.

Map Reference: Map ER86-1-2, location GL5.

Description of Deposit:

The deposit consists of two parallel quartz veins that occur within a quartz-feldspar porphyry dyke. The Jowsey or A vein is at least 96 m long and has an average width of 1.36 m. The Akers vein is 1672 m in length

[1]The lake name is spelled Gods Lake, the company name is spelled God's Lake.

Figure 21. General geology in the area of the Gods Lake Mine (after God's Lake Gold Mines Limited, company map).

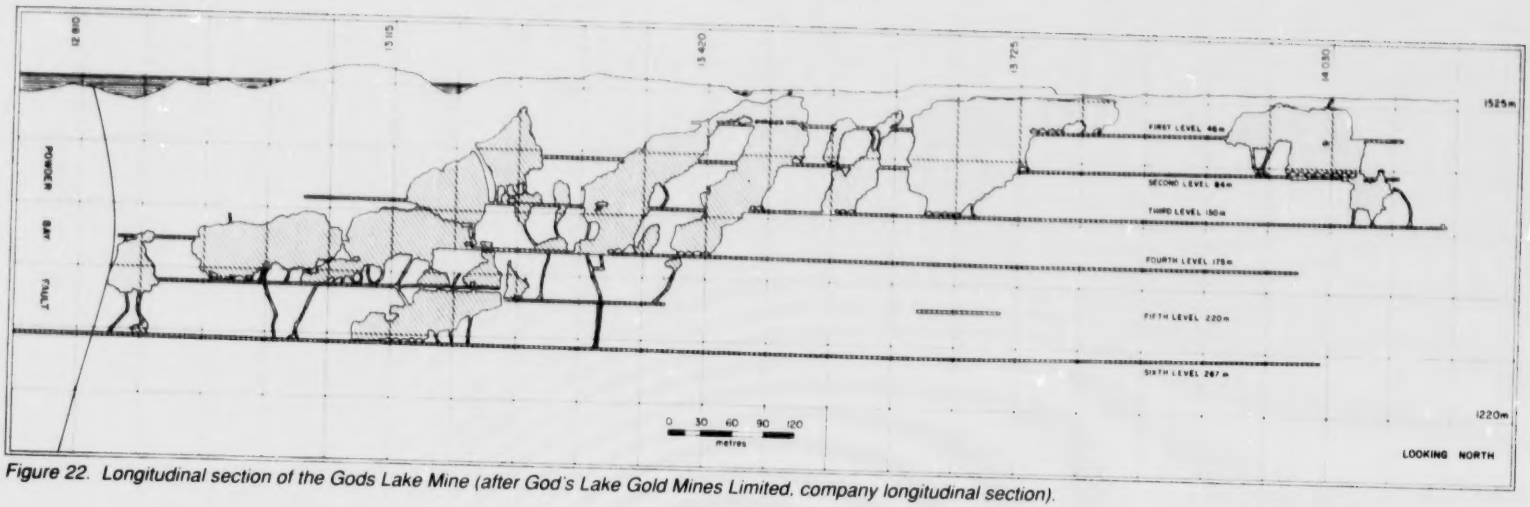


Figure 22. Longitudinal section of the Gods Lake Mine (after God's Lake Gold Mines Limited, company longitudinal section).

Figure 23. *Aerial view of the Gods Lake Mine site (photograph courtesy of Manitoba Culture, Heritage and Recreation: Provincial Archives).*

and up to 3 m in width. The veins are composed of grey to black quartz with disseminated pyrite, arsenopyrite, chalcopyrite, minor pyrrhotite and traces of visible gold.

History of Exploration and Development:

The initial discovery was made in 1932 by R.J. Jowsey, A. McDonald and R. Howie. In 1934 Jowsey Island Gold Mines Limited sank a 70 m shaft with levels at 30 m and 61 m. Drifting on the Jowsey vein outlined two mineralized zones on the 30 m level and one zone on the 61 m level. Following are assay results from these zones:

Mineralized Zone	Length	Width	Assay g tonne (oz ton) gold	
1-A1	34.4 m	1.67 m	16.12	(0.47)
1-A2	34.7 m	1.10 m	6.86	(0.20)
2-A	23.7 m	1.95 m	8.23	(0.24)

A series of 15 horizontal drill holes was collared to the north and south of the 61 m level without intersecting significant mineralization. Operations were discontinued in July 1936.

Selected Bibliography: Baker (1935); Barry (1961); Quinn and Currie (1961); Davies et al. (1962); De Wet (1936); Dix (1951); Manitoba Mines Branch, Corporation File (God's Lake Gold Mines, Limited, Jowsey Island Gold Mines, Limited), Mineral Inventory File (53 L 9NW Au1); Marten and Gilbert (1973); Wright (1932).

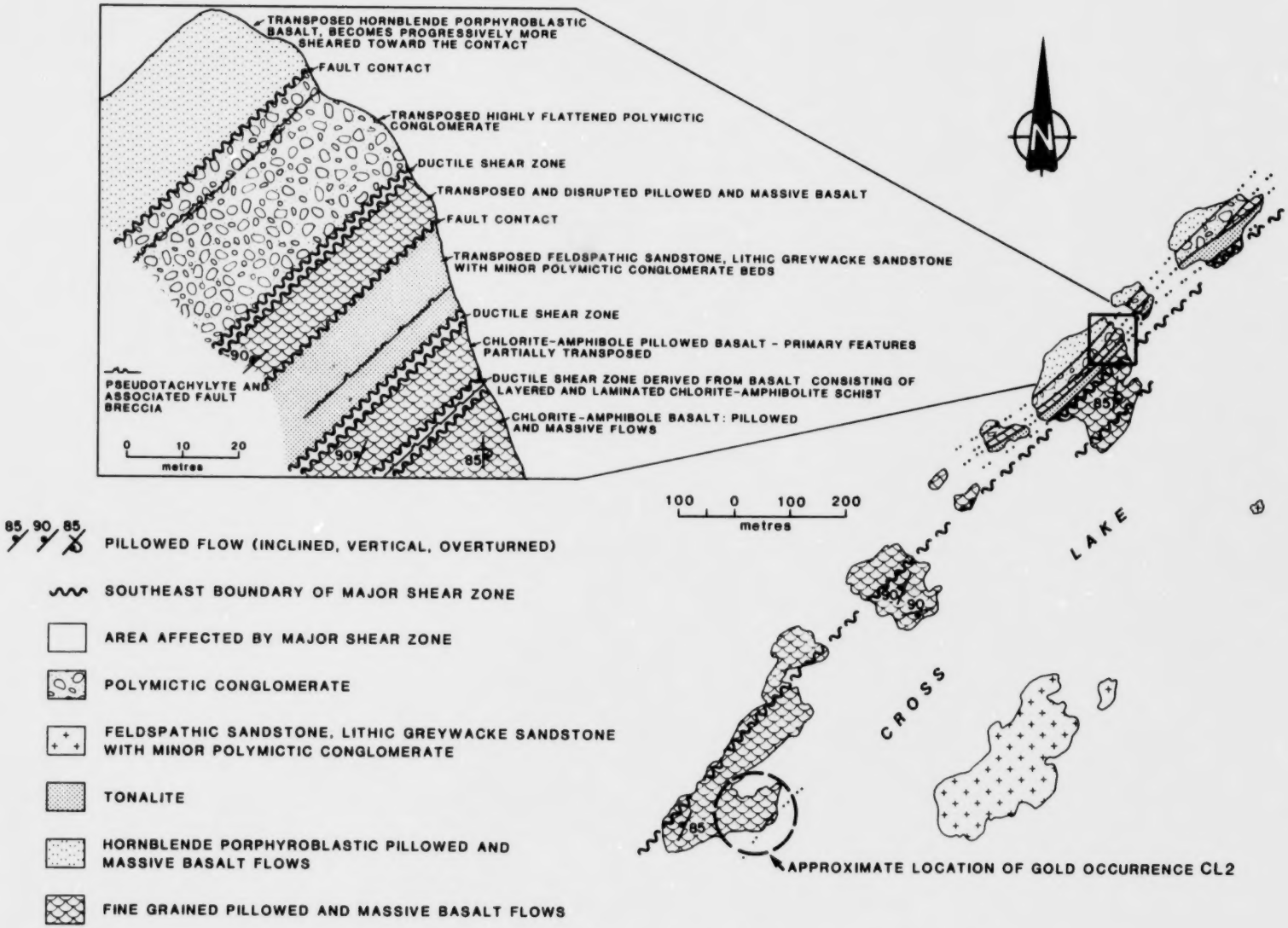

TRANSPOSED HORNBLENDE PORPHYROBLASTIC BASALT, BECOMES PROGRESSIVELY MORE SHEARED TOWARD THE CONTACT
FAULT CONTACT
TRANSPOSED HIGHLY FLATTENED POLYMICTIC CONGLOMERATE
DUCTILE SHEAR ZONE
TRANSPOSED AND DISRUPTED PILLOWED AND MASSIVE BASALT
FAULT CONTACT
TRANSPOSED FELDSPATHIC SANDSTONE, LITHIC GREYWACKE SANDSTONE WITH MINOR POLYMICTIC CONGLOMERATE BEDS
DUCTILE SHEAR ZONE
CHLORITE-AMPHIBOLE PILLOWED BASALT - PRIMARY FEATURES PARTIALLY TRANSPOSED
DUCTILE SHEAR ZONE DERIVED FROM BASALT CONSISTING OF LAYERED AND LAMINATED CHLORITE-AMPHIBOLITE SCHIST
CHLORITE-AMPHIBOLE BASALT: PILLOWED AND MASSIVE FLOWS
PSEUDOTACHYLYTE AND ASSOCIATED FAULT BRECCIA
0 10 20
metres
N
100 0 100 200
metres
LAKE
CROSS
85 90 85
PILLOWED FLOW (INCLINED, VERTICAL, OVERTURNED)
SOUTHEAST BOUNDARY OF MAJOR SHEAR ZONE
AREA AFFECTED BY MAJOR SHEAR ZONE
POLYMICTIC CONGLOMERATE
FELDSPATHIC SANDSTONE, LITHIC GREYWACKE SANDSTONE WITH MINOR POLYMICTIC CONGLOMERATE
TONALITE
HORNBLENDE PORPHYROBLASTIC PILLOWED AND MASSIVE BASALT FLOWS
FINE GRAINED PILLOWED AND MASSIVE BASALT FLOWS
APPROXIMATE LOCATION OF GOLD OCCURRENCE CL2

Figure 24. General geology in the area of the Scott No. 1 occurrence (after Corkery and Lenton, 1984).

CROSS LAKE-PIPESTONE LAKE-ECHIMAMISH RIVER AREA

EGIONAL GEOLOGY

ıtroduction

The Cross Lake-Pipestone Lake-Echimamish River area has been reviously described by Alcock (1920a), Horwood (1934), Tanton (1937), lousell (1966), Corkery (1983, 1985a), and Corkery and Lenton (1984): is underlain by a volcano-sedimentary greenstone belt that extends rom the southern Cross Lake area in two branches: one branch trends ortheast, and the second branch trends southeast from Cross Lake to ipestone Lake and then easterly to the Butterfly Lake-Echimamish River rea (Map ER86-1-2). The belts consist of an older sequence of Early upracrustal rocks that have been intruded by Early Plutonic rocks (Table). These rocks are unconformably overlain by the Cross Lake Group edimentary rocks and are intruded by granite batholiths and plutons, egmatites and mafic dykes. The supracrustal rocks exhibit mineral ssemblages indicative of upper greenschist to middle amphibolite facies rade metamorphism.

A detailed structural analysis of the area has not been carried out; owever, Rousell (1966) recognized two major synclines — the first has a fold axis striking northeast and the second has a fold axis striking southeast. Crossfolds trend north-northwest and north-northeast.

K-Ar dates from biotites in granite gneisses range from 2500 to 1840 Ma (Burwash et al., 1962).

TABLE 5
GENERAL STRATIGRAPHY OF THE CROSS LAKE AREA
(condensed from Corkery, 1985a)

PROTEROZOIC	Molson dyke swarm
ARCHEAN	
Late Plutonic Rocks	granite batholiths and quartz-feldspar porphyry, gabbro and diorite plugs
— — — — — — — Intrusive contact — — — — — — —	
Cross Lake Group	sandstone, siltstone, calcarenite, porphyritic basalt felsite porphyry, felsic sediments sandstone, pebbly sandstone polymictic conglomerate
— — — — — — — Unconformity — — — — — — —	
Early Plutonic Rocks	tonalite mafic-ultramafic intrusive rocks
— — — — — — — Intrusive contact — — — — — — —	
Early Supracrustal Rocks	volcanic conglomerate, greywacke, iron formation, pillowed and massive flows, oligomictic flow breccia, layered amphibolite, chlorite-talc schist

Early Supracrustal Rocks

Early Supracrustal rocks are predominantly pillowed and massive basalt flows (where primary structures are preserved). Locally greywacke and iron formation were observed within the volcanic rocks.

Early Plutonic Rocks

Early Plutonic rocks consist of mafic dykes, layered anorthositic gabbro and anorthosite, a layered ultramafic sill and a granitic intrusive complex.

Cross Lake Group

The Cross Lake Group consists of polymictic conglomerate, felsic sandstone, siltstone and shale. Basalt flows occur as local interbeds within sedimentary rocks on an island in central Pipestone Lake.

Late Plutonic Rocks

Late Plutonic rocks consist of major granitic batholiths and rare-element-enriched pegmatites.

Molson Dyke Swarm

Mafic dykes of the Molson Dyke Swarm are the youngest rocks of the area. They strike northeast and dip vertically.

MINERALIZATION

Gold has been found at two locations in the Cross Lake area: 1) the O'Day occurrence (CL1), 15 km east of Butterfly Lake and northeast of the easternmost bay of Birch Lake; and 2) the Scott No. 1 occurrence (CL2), located on an island in the central part of Island Lake (Map ER86-1-2, Fig. 24). Alcock (1920a) also reported that quartz veins on the north shore of Pipestone Lake contain trace amounts of gold.

At the O'Day occurrence a quartz vein in chlorite schist contains disseminations of arsenopyrite, pyrrhotite, chalcopyrite and up to 1.3 mm in diameter gold grains (Tanton, 1937). A channel sample of the quartz vein assayed 77.15 g/tonne (2.25 oz/ton) gold over a width of 1.2 m. In 1984 and 1985 joint venture partners Kennco Explorations Ltd. and Claude Resources Inc. carried out prospecting, mapping and geophysical surveys in the Butterfly Lake-Echimamish River area.

The location and geology of the Scott No. 1 occurrence is poorly documented. Tanton (1937) observed the presence of gold, pyrite, pyrrhotite and arsenopyrite in quartz-filled shear zones in the area of the hook-shaped island on Figure 24 (Tanton, 1937). The mineralization may occur within or southeast of an area that Corkery and Lenton (1984) described as an arcuate tectonic zone 50 to 100 m thick consisting of irregularly spaced 1 to 4 m wide shear zones.

CHURCHILL-SUPERIOR BOUNDARY ZONE

REGIONAL GEOLOGY

The Churchill-Superior Boundary Zone in Manitoba consists of three segments: Thompson Nickel Belt, Split Lake Block and Fox River Volcanic Belt. The north and northwest margin of the boundary zone is in fault contact with paragneisses of the Churchill Province. The southern and southeastern contact is placed where Archean gneisses grade into granulite facies rocks of the Pikwitonei Granulite Domain (Map ER86-1-2, in pocket).

The Thompson Nickel Belt is underlain predominantly by migmatitic and layered cataclastic felsic gneisses. Supracrustal rocks of the belt, called the Ospwagan Group, form narrow elongate lenses of metavolcanic, metasedimentary and ultramafic rocks that occur as folded sequences within the migmatites and gneisses. Metavolcanic rocks consist of massive and pillowed flows. Metasedimentary rocks consist of: laminated siltstone, sandstone, quartzite, shale, phyllite, dolomite and iron formation. Ultramafic rocks are dominantly serpentinites that occur as numerous pods and sill-like masses within the Ospwagan Group and migmatitic gneisses. Green et al. (1985), based on work carried out by Cummings et al. (1982) and Brooks and Theyer (1981), inferred a minimum age of 2320 0.03 Ma for supracrustal rocks of the Thompson Nickel Belt.

The Split Lake Block comprises cataclastic amphibolite, granite to tonalite gneisses, anorthosite and layered mylonites (Corkery, 1985b).

The Fox River Volcanic Belt contains sedimentary rocks, large differentiated sills and ultramafic to mafic volcanic rocks. They form a north-facing monoclinal sequence that is interpreted to have been deposited upon Superior Province gneisses (Scoates, 1981). Metamorphism ranged from lower greenschist in the lower sequences to subgreenschist in the upper sequences. Total rock Rb-Sr age determinations on rocks of the Fox River Sill yield an age of 1720 Ma (Scoates and Clark, unpublished data). More precise U-Pb age dates on zircons establish a date of 1883 1.5 Ma for emplacement of the sill (Heaman et al., 1986).

MINERALIZATION

Gold mineralization occurs in the Split Lake Block at the north end of Assean Lake, 105 km northeast of Thompson. At the Dunbrack and the Lindal occurrences (Map ER86-1-2, locations SL1,2) discontinuous quartz veins that parallel foliation in biotite gneiss, lit-par-lit gneisses, quartzofeldspathic mylonites and cataclastic plagioclase amphibolite contain galena, sphalerite, chalcopyrite, pyrite, and locally visible gold (Haugh, 1969).

Sherritt Gordon Mines Ltd. drilled eleven holes along the Dunbrack vein in 1938. Of these, eight intersected a quartz vein that yielded assays ranging from 4.11 g/tonne (0.12 oz/ton) to 33.60 g/tonne (0.98 oz/ton) gold over widths of 0.49 to 0.92 m (Manitoba Energy and Mines, Mines Branch, Mineral Inventory File, 64 A/1 Au1). In 1983 Nor-Acme Gold Mines, Limited and joint venture partner Arbor Resources Inc. were active in the area and completed an exploration program that consisted of trenching, sampling and diamond drilling. In 1986 Homestake Mineral Development Company optioned Nor-Acme's Assean Lake property and completed a winter drill program.

FLIN FLON-SNOW LAKE GREENSTONE BELT

REGIONAL GEOLOGY

Introduction

The early Proterozoic (Aphebian) Flin Flon-Snow Lake volcanic-sedimentary (greenstone) belt is situated in the southeastern Churchill Structural Province of the Canadian Shield. The greenstone belt has approximate dimensions of 250 km east-west by 50 km north-south and extends from 30 km east of Snow Lake, Manitoba to 50 km west of Flin Flon, Manitoba into the province of Saskatchewan (Map ER86-1-3, in pocket).

The Flin Flon-Snow Lake greenstone belt has gradational and/or fault contacts with the Kisseynew metasedimentary gneiss terrain to the north and is unconformably overlain by Ordovician dolomites and limestones along its southern margin. Throughout the belt the supracrustals have been divided into the volcanic and derived sedimentary rocks of the Amisk Group and the unconformably overlying terrestrial sedimentary rocks of the Missi Group after their type exposures at Amisk Lake, Saskatchewan (Bruce 1918).

Numerous pre- to post-tectonic felsic-mafic dykes, stocks and sills intrude the Flin Flon-Snow Lake greenstone belt. Supracrustal rocks in the Flin Flon, Elbow Lake and File Lake-Snow Lake areas are separated by post-Missi batholiths of granodioritic-granitic composition that segment the belt.

Amisk Group

The Amisk Group are the oldest rocks in the Flin Flon-Snow Lake belt. Total rock Rb/Sr and K/Ar determinations (Mukherjee et al., 1971) and more recent U-Pb zircon ages favour an Aphebian age for the volcanic rocks, the earliest extrusive event occurring at approximately 1900 Ma (Gordon et al., 1987). The Amisk Group comprises a thick sequence of mafic to felsic flows, related breccias, volcaniclastic deposits and volcanogenic sedimentary units. Most rocks were deposited in a shallow to deep subaqueous environment but subaerial environments have been recognized locally (Ayres, 1978). Syme et al. (1982) have recognized an intact Amisk Group rock succession of approximately 5100 m thickness in the Flin Flon area.

On the basis of detailed mapping in the Flin Flon region Bailes and Syme (1979-1984) have determined that the basic structural pattern in that area is dominated by numerous fault-bounded blocks, each characterized by a unique stratigraphic sequence of Amisk Group rocks that cannot be correlated with sequences in adjacent blocks.

Stauffer et al. (1975) estimate that approximately 85% of the Amisk Group in the Flin Flon area consists of mafic to intermediate volcanic rocks. Felsic volcanic rocks occur at numerous stratigraphic levels and are important locally (Syme et al., 1982). Volcanogenic greywacke, siltstone, mudstone and chert layers are relatively rare in this area but occur throughout the volcanic rock sequences, more commonly near their tops (Byers and Dahlstrom, 1954; Bailes and Syme, 1979-1984).

In the Elbow Lake area McGlynn (1959) estimated that the Amisk Group comprises up to 5700 m of dominantly mafic volcanic flows and associated pyroclastic units; felsic volcanic rocks and siliceous iron formation are locally important intercalations. Sedimentary strata, commonly biotite schists or gneisses with local quartzite layers, form a distinct unit overlying the volcanic derived rocks that McGlynn (1959) correlated with Amisk sedimentary rocks of the Flin Flon area. More recently Galley et al. (1985) divided the supracrustal rocks in the Elbow Lake area into three zones, each characterized by a unique lithologic sequence, i.e.: 1) mafic flows with minor pyroclastic rocks; 2) tuffaceous rocks now altered to chlorite-carbonate sericite schists with minor iron formation; and 3) well layered tuffs, gradational into mafic volcanic rocks. Neither McGlynn (1959) nor Galley et al. (1985) identified Missi-type rocks in the Elbow Lake area.

The Amisk Group in the File Lake-Snow Lake area comprises mafic to felsic volcanic rocks with intercalated volcanogenic sedimentary units that become dominant near the top of the succession (Harrison, 1949; Froese and Moore, 1980; Bailes, 1980; Walford and Franklin, 1982). In the File Lake area Bailes (1980) estimated that the dominantly volcanic succession is at least 2000 m thick and consists of 80% mafic flow rocks and related breccias with thick accumulations of felsic volcanic rocks constituting the remainder. At Snow Lake felsic volcanic rocks are as abundant as mafic volcanic rocks within the Amisk Group (Walford and Franklin, 1982). Up to 1000 m of volcanogenic greywacke, siltstone and mudstone deposited by turbidity currents overlies the volcanic rock sequence and this sedimentary unit has been assigned to the Amisk Group (Froese and Moore, 1980; Bailes, 1980). The overlying turbidite succession and the substantial volume of felsic rocks, particularly in the immediate vicinity of Snow Lake, distinguish the Amisk Group in this area from that in the Flin Flon region (Syme et al., 1982).

Chemically, the Amisk Group volcanic rocks exhibit both tholeiitic and calc-alkaline affinities (Stauffer et al. 1975; Fox, 1976). The prevalence of pillowed lavas, mafic to felsic volcanism, submarine volcaniclastics and turbidite deposits and the tholeiitic chemical affinity displayed by the least altered mafic volcanic rocks suggest deposition in an island-arc tectonic environment (Stauffer et al., 1975; Fox, 1976; Syme et al., 1982).

Missi Group

The Missi Group is the youngest supracrustal succession in the Flin Flon greenstone belt. It comprises up to 3000 m of thin bedded to massive sandstone, pebbly sandstone and/or polymictic conglomerate. The lensoidal nature of units, their generally arkosic composition, ubiquitous presence of accessory hematite and/or magnetite, variations in sorting, small- to medium-scale crossbedding, scour and fill structures and lack of fine sedimentary material, ripple marks and flute casts indicate deposition in an alluvial/fluvial environment (Mukherjee, 1971; Stauffer, 1974; Bailes and Syme, 1983). Missi Group rocks similar to those outcropping in the Flin Flon and File Lake-Snow Lake areas have not been identified at Elbow Lake.

In the Flin Flon area Bailes and Syme (1983) have delineated a major angular unconformity between the Amisk and Missi Groups that truncates at least 2500 m of Amisk strata. The unconformity is marked locally by a hematitic regolith up to several metres thick.

At Snow Lake Froese and Moore (1980) describe rocks of the Missi Group succession as a monotonous sequence of metamorphosed lithic arenites. The Missi Group of the File Lake and Snow Lake areas differs from the Missi Group at its type localities in the Flin Flon region by the relative absence of conglomerate layers and apparently conformable deposition over turbiditic greywacke units rather than subaerially weathered volcanic rocks (Bailes, 1980; Froese and Moore, 1980).

Volcanic rocks that include welded tuffs have been identified in the Missi Group east of Wekusko Lake in the Snow Lake area (Shanks and Bailes, 1977; Gordon and Gall, 1982). The volcanic rocks are predominantly fragmental felsic units; however, massive intermediate flows and related breccias occur locally. The lack of pillow structures and presence of welded tuffs led Shanks and Bailes (1977) and Gordon and Gall (1982) to infer a subaerial environment of deposition.

Intrusive Rocks

Intrusive rocks of various ages and compositions occur throughout the Flin Flon-Snow Lake belt. The earliest intrusions recognized are synvolcanic mafic to felsic sills and dykes, and granitoid, commonly porphyritic plutons that are restricted to the Amisk Group and related to Amisk volcanism (Bailes and Syme, 1980-1984; Baldwin, 1980; Walford and Franklin, 1982). Numerous strongly differentiated gabbroic sills, some possibly synvolcanic, occur throughout the belt and have been documented in the Flin Flon (Bailes and Syme, 1979; 1980; 1982), File Lake (Bailes, 1980) and Snow Lake (Williams, 1966) areas.

Evidence of a plutonic event occurring after the cessation of Amisk volcanism and prior to deposition of the Missi Group is suggested by Stauffer (1974) who identified a heterogeneous granitoid complex unconformably overlain by Missi strata near Flin Flon. In addition, the widespread occurrence of granitic clasts in the Missi suggests that plutonism, uplift and erosion took place prior to Missi Group sedimentation.

Larger granitic-granodioritic plutons of up to batholithic dimensions intrude and, in places, segment the belt. These intrusions are considered to be largely syntectonic as their margins are broadly concordant with stratigraphy of the adjacent greenstone belt and contain the same foliation as the supracrustal rocks (Price, 1977). Late granitic and pegmatitic intrusions cut all earlier rocks.

METAMORPHISM

Regional metamorphism began after deposition of the Missi Group. Mukherjee et al. (1971) determined Rb/Sr age dates for Amisk rocks in the Flin Flon area that reflect an approximate metamorphic age of 1775 89 Ma. In the Snow Lake area metamorphism probably began during the waning stages of Missi magmatism (1832 2 Ma) and continued to approximately 1800 Ma (Gordon et al., 1987). The majority of supracrustal rocks in the Flin Flon area have undergone lower to middle greenschist grades of metamorphism; however, volcanic rocks that exhibit subgreenschist (prehnite-pumpellyite) mineral assemblages have been identified locally (Bailes and Syme, 1983; Syme, 1985b). Notwithstanding inherent recrystallization of the sedimentary and volcanic rocks primary depositional features are well preserved. Regional metamorphism throughout the greenstone belt exhibits a general increase in grade from south to north (Harrison, 1949; McGlynn, 1959; Bailes and McRitchie, 1978; Froese and Moore, 1980). Near the north margin of the belt at or close to the contact with the Kisseynew gneiss belt metamorphic grades commonly reach almandine-amphibolite facies. Locally, east-trending prograde metamorphic isograd reactions within pelitic rocks have been mapped north into the Kisseynew gneisses (Harrison, 1949; Bailes and McRitchie, 1978; Froese and Moore, 1980).

Grades of metamorphism in the Snow Lake area are generally higher than those documented elsewhere in the belt. Froese and Moore (1980) recognized four metamorphic zones in this area that range from a lower amphibolite zone north to an upper amphibolite zone. Despite the higher grades of metamorphism in this area primary depositional features are relatively well preserved in the volcanic and sedimentary rocks; however, massive sulphide deposits in this region and related footwall alteration zones exhibit coarse grained recrystallization textures with spectacular growths of metamorphic minerals.

STRUCTURE

Based on observations within rocks of the Missi Group near Flin Flon, Stauffer and Mukherjee (1971) recognized three periods of folding. These deformational events were applied to the Amisk Group as the Amisk and Missi Groups were considered to be in structural conformity. The recognition of a major angular unconformity between the Amisk and Missi strata in the Flin Flon area (Bailes and Syme, 1983) suggests that at least one deformational event preceded deposition of the Missi Group. Subsequently Bailes et al. (1987) have recognized five phases of folding that include one phase of pre-Missi folding and four that postdate deposition of the Missi Group. During the last folding event major faults were initiated that bound major stratigraphic blocks and dominate the structural fabric of the Flin Flon area (Bailes et al., 1987). Considerable movement along these faults is evidenced by a unique stratigraphy within each block that cannot be correlated across these faults and the juxtaposition of rocks that exhibit contrasting metamorphic mineral assemblages (Bailes and Syme, 1979-1984).

In the File Lake-Snow Lake area three periods of folding have been recognized, all considered post-Missi (Bailes, 1980; Froese and Moore, 1980). Early isoclinal folds have been refolded about northeasterly trending open folds (for example, the Threehouse Syncline at Snow Lake). At File Lake Bailes (1980) has recognized a third folding event consisting of easterly trending open flexural folds. Deformation associated with minor folds that postdate the second phase of folding in the Snow Lake area were observed in the immediate vicinity of gneissic domes on the north margin of the belt and are considered to be related to increased tightening of second phase folds (Froese and Moore, 1980). The McLeod Lake thrust fault (Russell, 1957), a major structural break in the Snow lake area, is interpreted to represent an early nappe structure associated with the early isoclinal folding (Froese and Moore, 1980).

MINERALIZATION

Intrusive and supracrustal rocks of the Flin Flon greenstone belt host a large number of gold occurrences in a wide variety of geological settings (Map ER86-1-3). Although the Nor-Acme Mine north of Snow Lake was the only major past producer of gold in the belt, there have been a number of past producers in the Flin Flon, Elbow Lake and Wekusko Lake areas. Recent exploration led to the discovery of sizeable deposits near Flin Flon (Tartan Lake) and Snow Lake (Snow Lake Mines) (Map ER86-1-3, locations FF4, 10). Gold is also associated with base metal massive sulphide deposits throughout the belt (Gale et al., 1980; Franklin and Thorpe, 1982) and is commonly a by-product.

In the File Lake-Snow Lake area primary gold mineralization is known: 1) on the east shore of Wekusko Lake (Herb Lake Camp); 2) north of the town of Snow Lake; and 3) in the vicinity of North Star Lake. Descriptions of deposits in these areas include those by Alcock (1920b), Wright (1931), Stockwell (1935, 1937) and more recently Galley et al. (1986).

Gold mineralization in the Herb Lake camp occurs in sedimentary and volcanic rocks of the Missi Group that outcrop on the east shore of Wekusko Lake. Past producers include the Moose Horn (Ballast), Laguna (Rex), Bingo and Ferro Mines. Stockwell (1937) divided the gold occurrences in this area into two major groups: 1) those aligned along the north limb of the Herb Lake syncline, near the contact between sedimentary and volcanic rocks of the Missi Group; and 2) those aligned subparallel and in proximity to the axial trace of the syncline *(Fig. 25)*.

Occurrences on the north limb comprise gold-arsenopyrite mineralization in quartz veins and lenses that strike north-northeast, parallel to both the regional stratigraphy and a major fault that occurs along the east shore of the lake. Most occurrences are contained within or exhibit a spatial association to quartz-feldspar-phyric units that have been interpreted as felsic intrusive (Stockwell, 1937), volcaniclastic (Gordon and Gall, 1982) or possibly both intrusive and extrusive (Galley et al., 1986). Within the felsic porphyritic rocks mineralization is associated with distinct quartz veins whereas in the sedimentary rocks and mafic dykes mineralization is associated with irregular quartz lenses and stringers in shear zones (Galley et al., 1986). Sericite and/or carbonate alteration is

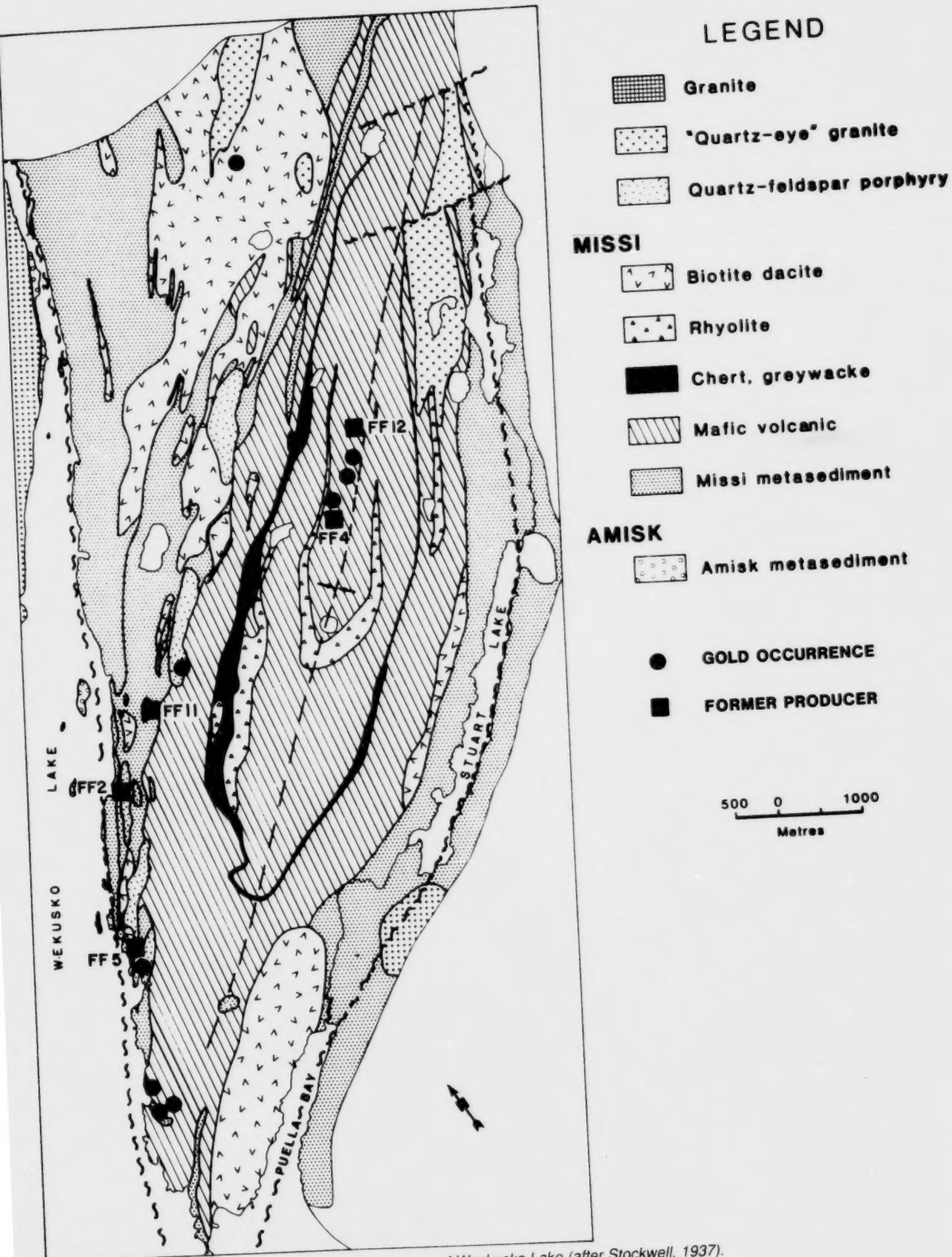


Figure 25. General geology and gold occurrences east of Weskusko Lake (after Stockwell, 1937).

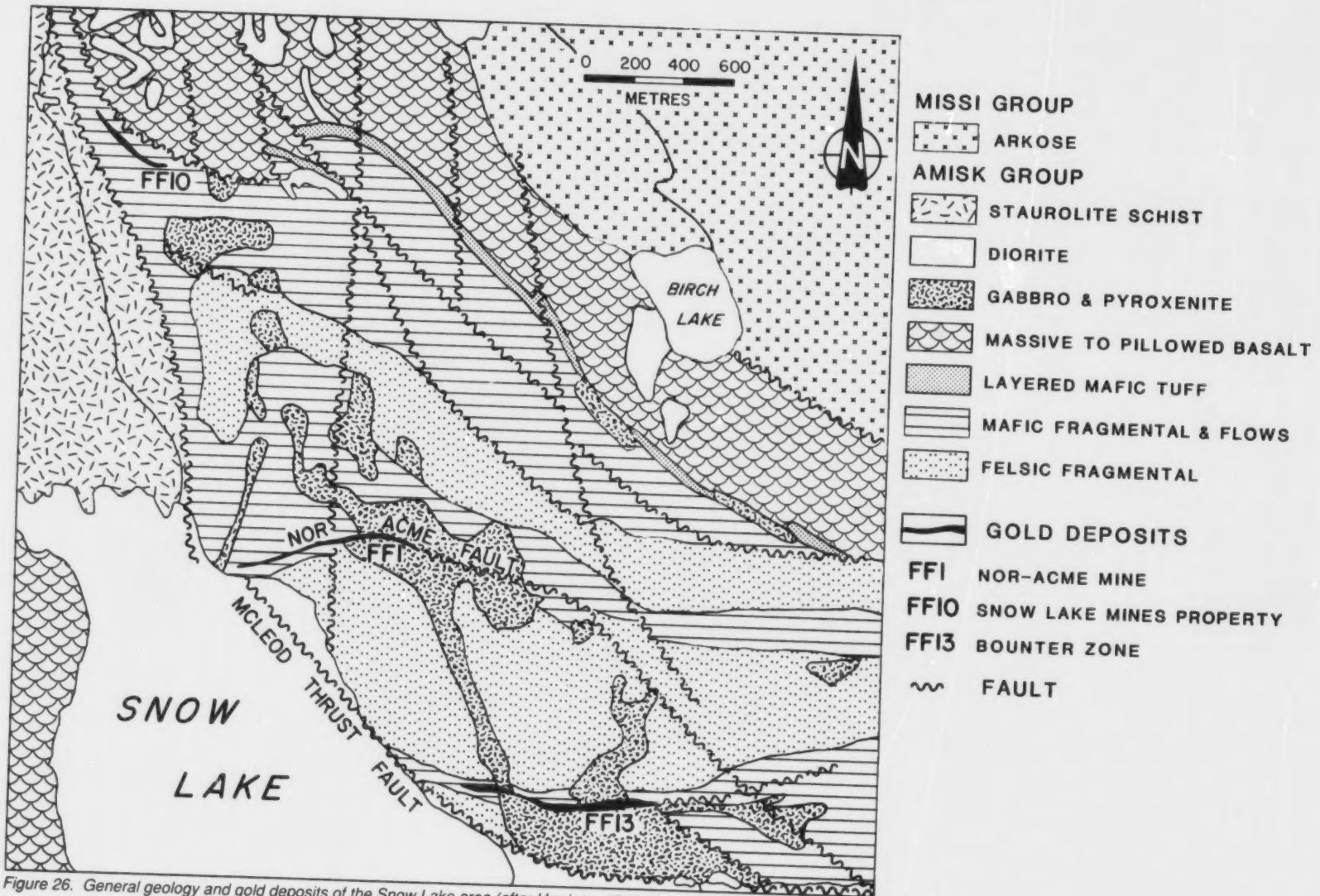


Figure 26. General geology and gold deposits of the Snow Lake area (after Harrison, 1949; Froese and Moore, 1980; and Galley et al., 1986).

associated with the mineralization. Alteration within the felsic porphyritic units is poorly developed and in the shear zones usually occurs within 1 m of the quartz lenses and stringers. Galley et al. (1986) interpret the alteration event(s) to have overprinted the regional metamorphic mineral assemblages that Froese and Moore (1980) interpret as having developed during or later than the second major folding event.

The axial trace occurrences consist of gold-pyrite mineralization in quartz lenses and stringers hosted by mafic volcanic rocks, now altered to biotite schist. Galley et al. (1986) have not identified arsenopyrite in association with this mineralization. However, Wright (1931) reported minor amounts of arsenopyrite in old workings at the north end of the Rainbow Group occurrences (Fig. 25, location FF12).

Gold deposits in the Snow Lake area include the Squall Lake, Bounter and Snow Lake Mines Ltd. (formerly Gold Fields) prospects and the Nor-Acme Mine. The Squall Lake deposit is discussed below, in the mineralization summary of the Kisseynew gneiss belt. Descriptions of these deposits have been given most recently by Galley et al. (1986) and Bailes et al. (1987). Earlier geologic accounts of the Nor-Acme deposit include those by Wright (1931), Ebbutt (1944) and Harrison (1949).

The Nor-Acme, Snow Lake Mines and Bounter deposits occur within a block of Amisk Group volcanic rocks that is bounded on the west and south by the McLeod Road thrust fault. The volcanic rocks are characterized by felsic and mafic fragmental units. All deposits exhibit a spatial association to faults that are subparallel to, merge with and terminate on the McLeod Road thrust (Fig. 26). Galley et al. (1986) suggest these faults may represent splays off the McLeod thrust fault.

Bailes et al. (1987) list common features of the mineralization that include:

1. auriferous veins and stringers characterized by quartz carbonate-plagioclase breccia with incorporated altered wall rock;
2. intense wallrock alteration, up to several metres from the mineralization characterized by biotite, chlorite, carbonate and tourmaline;
3. associated quartz-carbonate-tourmaline veins in both hanging wall and footwall; and
4. associated sulphide minerals that include arsenopyrite (acicular crystals are associated with the best gold values) with lesser amounts of pyrite, pyrrhotite, chalcopyrite, sphalerite and galena.

Galley et al. (1986) interpret the wallrock alteration mineral assemblages associated with the gold mineralization to have overprinted and retrograded the regional metamorphic mineral assemblages.

Other gold occurrences in the Snow Lake area are described by Harrison (1949), Gonzales and Fedikow (1984), Eccles and Fedikow (1985) and Fedikow et al. (1986b). Isolated gold occurrences near File Lake have been documented by Stockwell (1935), Harrison (1949) and Ostry (1984).

Fifteen gold-quartz occurrences that are concentrated in an area immediately east and southeast of North Star Lake (6 km southwest of File Lake) are described in detail by Stockwell (1935). Mineralization consists of discontinuous lenses, veins and/or stringers of quartz that contain gold, pyrite and pyrrhotite with sphalerite, chalcopyrite, galena, carbonate and incorporated wall rock as locally important constituents. All occurrences are hosted by sheared andesitic and dacitic flow rocks that have been altered to chloritic schist and have locally been intruded by numerous felsic dykes and stocks of quartz-feldspar porphyry, quartz diorite and granite. The mineralized zones are parallel to or cut the regional schistosity at a shallow angle and postdate the intrusion of the felsic dykes and stocks. Most zones range in width from several centimetres up to 5 m and locally pinch and swell for up to 250 m along strike.

Gold mineralization in the Elbow Lake area has been described by Armstrong (1922), Wright (1931), Stockwell (1935), McGlynn (1959) and most recently by Galley et al. (1985). Galley et al. (1985) have divided the gold occurrences of this area into three groups: 1) occurrences that exhibit fault-controlled alteration and stockwork zones characterized by intense carbonate alteration with associated quartz-carbonate veins that form zones up to 20 m wide and 20-30 m long; 2) porphyry related occurrences that include the Century Mine (Map ER86-1-3, location FF7) and are characterized by disseminated arsenopyrite or quartz-carbonate veins associated with quartz-feldspar porphyry dykes; and 3) strata-bound occurrences within sulphide-rich and cherty strata and oxide facies iron formation.

In the Flin Flon area of Manitoba numerous gold occurrences are indicated on geology maps by Tanton (1941) and Bateman and Harrison (1945). Gale (1981) observed that these occurrences exhibited two major associations, namely: 1) near or at the margins of gabbroic intrusions; and 2) within felsic intrusions. The majority of occurrences that exhibit the second association occur within high level synvolcanic intrusions that locally contain porphyry-type Cu-Mo mineralization (Baldwin, 1980). Examples of the first type include the gold deposit at Tartan Lake and the gold occurrence at Alberts Lake (Map ER86-1-3, location FF14). At Tartan Lake the gold mineralization occurs in a number of easterly trending zones of alteration and shearing within intermediate to felsic volcaniclastic and gabbroic rocks at or near the margins of a gabbroic intrusive complex (Peloquin et al., 1985; Kreczmer and Deveaux, 1986; Peloquin et al., 1986). The gold occurs associated with disseminated pyrite and chalcopyrite in altered volcanic and gabbroic rocks or in crosscutting quartz-carbonate-tourmaline veins within the altered zones. Alteration comprises carbonatization, silicification, chloritization and pyritization that may predate the shearing (Peloquin et al., 1986). Fuchsite is common in the altered gabbroic rocks.

The Gurney Mine (Map ER86-1-3, location FF3) is described by Hage (1944) and Stewart (1980). Mineralization comprises gold-quartz-carbonate veins that crosscut a sequence of volcanic and sedimentary rocks. The supracrustal rocks are surrounded by granitic intrusions. Associated ore minerals include pyrite, pyrrhotite, chalcopyrite and galena with minor sphalerite and molybdenite. Quartz-carbonate and biotite-epidote-chlorite-carbonate-tourmaline-sericite are common wallrock alteration mineral assemblages. The mineralization is considered to be related to fracturing and shearing of the sedimentary and volcanic rocks during emplacement of nearby felsic plutons (Hage, 1944).

Other gold occurrences in the Flin Flon area have been documented by Stewart (1977), Gale (1981), Parbery and Gale (1984) and Parbery (1986).

PAST PRODUCERS

Nor-Acme Mine

Location: Snow Lake.

Map Reference: Map ER86-1-3, location FF1.

Description of Deposit:

The Nor-Acme property is underlain by Amisk Group mafic to felsic fragmental rocks, massive and pillowed flows, biotite schist and staurolite schist (Fig. 26). These rocks are intruded by dykes and irregular bodies of Post-Amisk Intrusive Group gabbro and pyroxenite.

Galley et al. (1986) observed that the gold-bearing zones occur subparallel to the Nor-Acme fault (formerly called the Howe Sound fault), an arcuate brittle ductile shear fault that splays off the McLeod thrust fault. The Nor-Acme fault strikes southwest at its western end and southeast at its eastern end and approximately parallels the contact between felsic pyroclastic rocks and mafic massive to pillowed flows. Gold mineralization forms an elongate body 300 m long on surface; however, at depth it occurs in four separate zones: the Toots, Dick, Ruttan and Hogg. The mineralization is associated with zones of intensely silicified, carbonatized, sheared or brecciated mafic and felsic rock around part of the Nor-Acme fault. The zones strike in an easterly direction, dip 45 north and

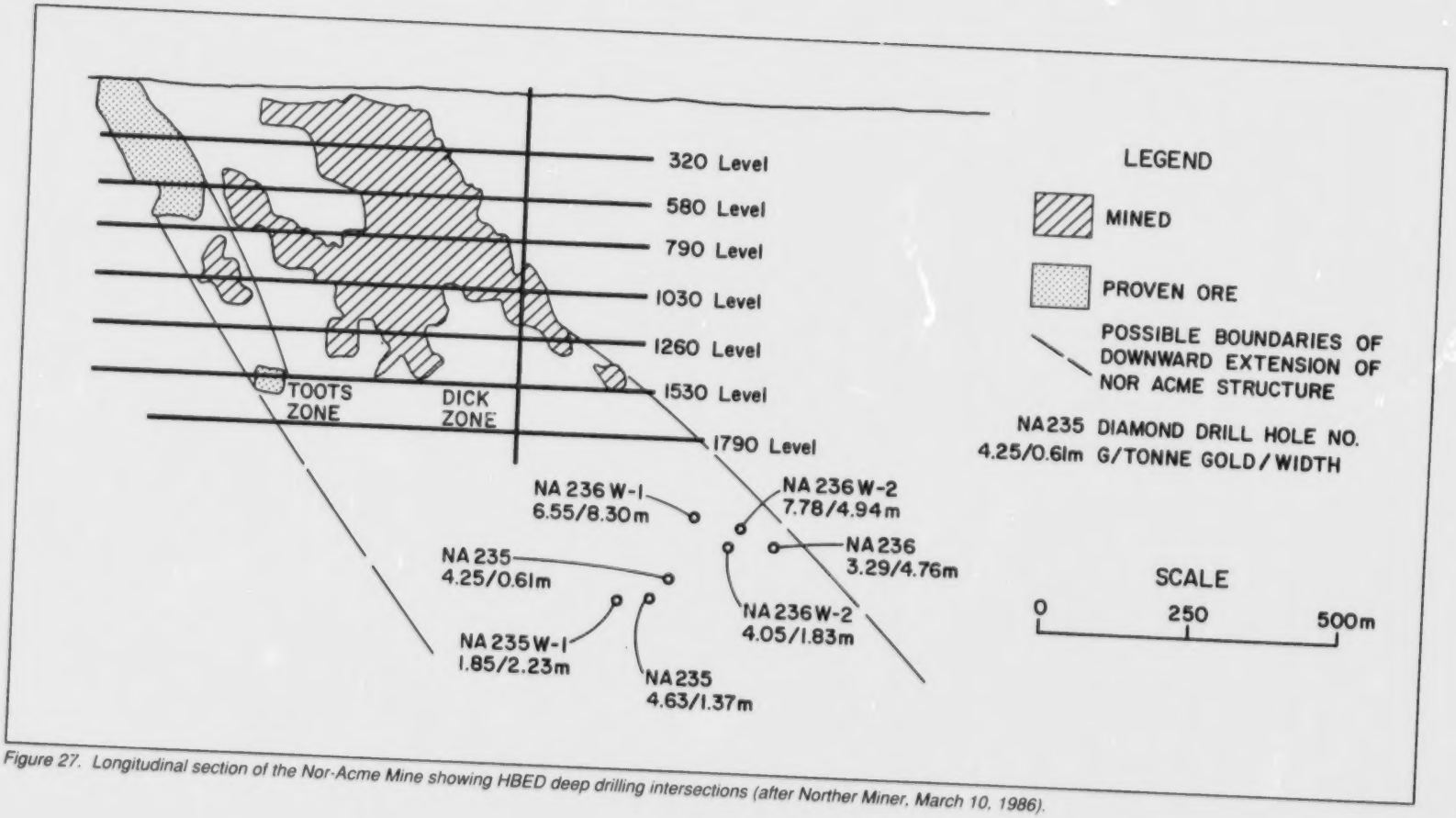


Figure 27. Longitudinal section of the Nor-Acme Mine showing HBED deep drilling intersections (after Norther Miner, March 10, 1986).

Figure 28. Aerial view of the Nor-Acme Mine site (1950).

plunge 030 to the northeast. Harrison (1949) suggested that the mineralized zones occur where the Nor-Acme fault truncates the nose of the Nor-Acme anticline.

Mineralization consists of 2% arsenopyrite, less than 1% pyrrhotite and less than 0.25 % pyrite. Small amounts of chalcopyrite, cubanite, sphalerite, galena, ilmenite and scheelite are also present. Gold occurs as minute lenticular masses and veinlets in openings on crystal boundaries and fractures in arsenopyrite. Galley et al. (1986) reported that the highest gold contents occur where acicular arsenopyrite forms radiating masses around wallrock fragments.

Froese and Moore (1980) stated that the localization of ore along the contact between felsic pyroclastic rocks and mafic flows suggests a syngenetic origin. Accordingly, they viewed the quartz and carbonate as products of chemical sedimentation rather than hydrothermal alteration. Galley et al. (1986), however, suggested that the gold mineralization was deposited during the waning stages of regional metamorphism and that large faults, such as the McLeod fault, acted as conduits channeling gold bearing fluids into secondary splay faults, such as the Nor-Acme fault.

History of Exploration and Development:

The property is covered by two claims, the Chums and Toots, both staked in 1925 by C.R. Parres. C.R. Parres, A.L. Parres and J. Parres carried out surface work from 1926 until 1938 when Nor-Acme Gold Mines Ltd. was formed to develop the property. Nor-Acme optioned the property to Howe Sound Exploration Company, Ltd (HSEC) who, during 1941 and 1942 drilled a total of 15 250 m on the property. This work outlined two orebodies containing an estimated 4 409 320 tonnes that averaged 5.14 g/tonne (0.15 oz/ton) gold to a depth of 305 m (Northern Miner, May 31, 1945).

Production started on June 1, 1949 and continued until July 1958. The mine was developed by a 600 m deep shaft with eight operating levels between 98 and 543 m.

On September 1, 1959 the property reverted to Nor-Acme Gold Mines Limited under the terms of the 1943 royalty-lease agreement with HSEC. Tests carried out in 1961 on a 227 000 tonne stockpile of arsenical concentrates indicated that it averaged 9.60 g/tonne (0.28 oz/ton) gold.

In 1980 Hudson Bay Exploration and Development Co. Ltd. (HBED) obtained a 2 year option, to acquire a 75% interest in the property. The 227 000 tonnes of arsenic concentrate was optioned by Bulora Corporation Limited and the option was subsequently taken over by Comiesa Corporation.

In 1981 HBED drilled 3880 m to test the downward extension of the deposit (Fig. 27). Significant drill intersections were as follows:

Hole	Interval	Assay g/tonne (oz/ton) gold	
NA-236	5.58 m	3.09	(0.09)
NA-236 W-1	23.49 m	6.51	(0.19)
NA-236 W-1	1.53 m	3.43	(0.10)
NA-236 W-1	1.83 m	6.17	(0.18)
N-236 W-2	5.80 m	7.78	(0.23)

Source: Northern Miner; April 9, 1981; October 22; November 12, 1981)

Based on the results of this drilling HBED estimated indicated reserves to total 2 510 889 tonnes grading 5.49 g/tonne (0.16 oz/ton) gold (Northern Miner, July 22, 1982).

In July 1982 HBED exercised its option on the Nor-Acme Mine through payment of a non-deductible installment of $100 000. The option was dropped in May 1986.

In 1986 Comiesa announced that an agreement was signed with Cobra Emerald Mines to build a gold recovery facility that will utilize bacterial leaching to process gold-cyanide-arsenic residues (Northern Miner, June 16, 1986, p. 1-2).

Figure 29. Laguna Mine site on the east shore of Wekusko Lake.

History of Production:

Year	Gold produced kg (oz.)
1949	1600 (51 468)
1950	2339 (75 188)
1951	2177 (69 994)
1952	2049 (65 861)
1953	2138 (68 737)
1954	2104 (67 659)
1955	2058 (66 152)
1956	1990 (63 990)
1957	1985 (63 813)
1958	1106 (35 569)
Total	19 546 (628 461)

Source: Nor-Acme Gold Mines Limited. Annual Reports (1949-1958).

Selected Bibliography: Bailes (1971); Davies et al. (1962); Ebbutt (1944); Galley et al. (1986); Harrison (1949); Hogg (1957); Manitoba Mines Branch, Corporation File (Nor-Acme Gold Mines Limited), Mineral Inventory (63 K/16NE Au1); Russell (1957); Wright (1931).

Laguna Mine (Rex)

Location: 19.5 km southeast of Snow Lake, near the east shore of Wekusko Lake.

Map Reference: Map ER86-1-3, location FF2.

Description of Deposit:

The property is underlain by stocks of quartz-feldspar porphyry that intrude Missi Group greywacke, conglomerate and arkose. Gold mineralization occurs in what Stockwell (1937) termed the "Main vein". It occurs in a linear zone of schistose rocks along the western margin of a lenticular stock of quartz-feldspar porphyry. The vein has been traced in surface trenches for a distance of 460 m, averages 0.8 m wide, strikes northeast and dips 70° southeast. The vein consists of white and blue-white sugary and coarse grained quartz. Fine to coarse grains of gold coat fractures in the quartz, usually in association with arsenopyrite; other sulphides occur in minor amounts. Pyrrhotite forms 2.5 m long streaks within quartz. Chalcopyrite is rare and is found associated with pyrrhotite. Galena forms rare inclusions in arsenopyrite. Numerous quartz stringers parallel and crosscut the Main vein.

History of Exploration and Development:

The property was first staked in 1914. In 1916 the Makeever Brothers took over unregistered interest in the property and commenced shaft sinking. In 1918 the Makeevers and the original stakers formed Herb Lake Gold Mines, Limited to develop the property. The mine operated from May to December of 1918 and recovered 40.6 kg (1306 oz.) gold. In 1920 J.R. Campbell operated the mine for six months.

In 1924 Herb Lake Consolidated Mines, Limited, was formed to develop the property. A 64 kg sample of ore sent to Ottawa for testing yielded bulk assays that ranged from 30.86 to 37.58 g/tonne (0.90 to 1.10 oz/ton) gold (Parsons, 1937). Based on these results the mine and mill were reopened. The Rex main shaft was deepend to 129 m and the mill processed 8890 tonnes between March 1924 and December 1925. The average head grade was 22.6 g/tonne (0.66 oz/ton) gold.

The property was dormant until Laguna Gold Mines Limited acquired the claims in 1934 and deepened the shaft to a depth of 343 m. Production started in 1936 and continued until 1940. The claims were then allowed to lapse.

Marshall Ballard staked the property in 1944. A 2-hole 17 m drill program was carried out on the claims before their cancellation in 1968.

W.B. Kobar staked the property in 1968. Trenching was carried out in 1977. In 1978 A.V. Harris Exploration Services acquired the property and undertook a program of linecutting and sampling. Norman Mines Ltd. acquired the property in 1980 but encountered financial problems that caused ownership to revert to A.V. Harris Exploration Services Limited who dealt it to Wekusko Gold Resources Limited. A biogeochemical survey was carried out in May 1984. In September 1984 Noranda Exploration Company Limited acquired the property as part of the

Laguna-Bingo option. They undertook a $50 000 program of linecutting, geological mapping, lithogeochemistry, soil sampling and geophysical surveys.

History of Production:

Year	Tonnes milled (oz/ton)	Grade g/tonne gold	Gold produced kg (oz.)
1918			41.5 (1 337)
1920	387.3		7.4 (237)
1921			2.7 (87)
1924	2 420.9		
1925	6 772.7		136.2 (4 379)
1926			12.0 (387)
1936	8 176.6		137.7 (4 428)
1937	26 888.3	17.40 (0.51)	461.0 (14 822)
1938	29 458.1	17.61 (0.51)	508.9 (16 360)
1939	28 761.4		514.4 (16 540)
1940	6 623		11.9 (385)
Total	109 488.3		1833.9 (58 962)

Source: Manitoba Mines Branch, Annual Reports.

Selected Bibliography: Alcock (1919); Bailes (1971); Bruce (1916); Davies et al. (1962); Harrison (1951a); Manitoba Mines Branch, Corporation Files (Herb Lake Gold Mines, Limited, Laguna Gold Mines Ltd., Mining Corporation of Canada), Mineral Inventory File (63 J/13SW Au1), Non-confidential Assessment File (90120); Parsons (1937); Reid (1938); Stockwell (1937); Wright (1931).

Gurney Mine

Location: 44 km east of Flin Flon, 1 km northwest of Brunne Lake.

Map Reference: Map ER86-1-3, location FF3.

Description of Deposit:

The property is underlain by a wedge of Amisk Group volcanic and sedimentary rocks that is intruded by granite and quartz diorite plutons. Amisk Group rocks consist of andesite and basalt flows, and greywacke, arkose and quartzite interbedded with dacite to rhyolite flows. Mineralization consists of clusters of pyrite, chalcopyrite and galena in closely spaced quartz veins within shear zones; gold occurs as microscopic particles in quartz, associated with galena. Mineralization also occurs in quartz associated with drag folds within a tuff bed (Dawson, 1937).

History of Exploration and Development:

The property was first staked in 1919. Wylie-Dominion Gold Mines Ltd. was incorporated in November 1933 to develop the property and in 1934 a 3-compartment vertical shaft was sunk to a depth of 51 m with one level established at 38 m. About 244 m of drifting and crosscutting outlined two deposits; the first grading 23.19 g/tonne (0.68 oz/ton) gold over a width of 1.16 m and a strike length of 29 m; and the second grading 12.57 g/tonne (0.37 oz/ton) gold over a width of 1.34 m and a strike length of 21 m.

In 1935 Gurney Gold Mines, Limited purchased the assets of Wylie Dominion Mines, Limited and deepened the shaft to a depth of 199 m. The mine was in production from 1937 to 1939. During this period 1174 m of drifting, 310 m of crosscutting and 2810 m of diamond drilling were completed. The Dominion claims lapsed in 1975.

The property was held by W.B. Dunlop from 1975 to 1977. Dunlop staked the area again in 1978. Kerr Addison Mines Limited optioned the property in 1978 and carried out linecutting, geophysical surveys and diamond drilling before the option was dropped in 1983.

History of Production:

Year	Tonnes milled	Gold production kg (oz.)
1937	4202	30.94 (995)
1938	42 910	399.39 (12 841)
1939	47 538	441.95 (14 209)
Total	94 650	872.28 (28 045)

Source: Manitoba Mines Branch, Annual Reports 1937-1939

Selected Bibliography: Bailes (1971); Davies et al. (1962); Dawson (1937); Manitoba Mines Branch, Annual Reports (1937-1939), Corporation File (Gurney Gold Mines, Limited, Wylie-Dominion Gold Mines Ltd.), Mineral Inventory File (63 K/11NE Au2); Hage (1944); Podolsky (1951).

Ferro-Rainbow

Location: 23 km southeast of Snow Lake.

Map Reference: Map ER86-1-3, location FF4.

Description of Deposit:

Gold occurs in quartz-filled shear zones and tension fractures in Missi group andesite flows. The shears and tension fractures are spatially associated with the northeast-trending Herb Lake syncline and occur predominantly on the west limb, in proximity to the fold axis. Stockwell (1937) mapped ten shear zones in the area of the Ferro-Rainbow property. Within the shear zones the andesite flows are altered to quartz-biotite schist and contain several gold-bearing quartz veins, lenses and stringers up to 1 m in width. Mineralization consists of pyrite, pyrrhotite, chalcopyrite, free gold and traces of arsenopyrite. Buff weathered carbonate stringers occur in the wall rocks and in the quartz.

History of Exploration and Development:

The property consists of the Ferro Mine and the Rainbow group claims.

Ferro Mine — The Ferro property was first staked in 1923. Work on the property up until 1940 consisted of surface sampling, trenching and operation of a small open cut that produced 16.28 kg (523.5 oz.) gold.

The Mining Corporation of Canada, Limited then acquired the property and in 1940 sank a vertical 3-compartment shaft to a depth of 52 m. Wekusko Consolidated Limited was formed in 1943 by several mining companies to develop the property. In 1947 shaft sinking deepened the shaft to 166 m, with levels at 84, 122, and 160 m. Reserves were estimated to be 45 355 tonnes grading 8.57 g tonne (0.25 oz ton) gold (Northern Miner, October, 1947). Financial problems caused work to be discontinued in January 1948. Wekusko Consolidated Limited was renamed Explorers Alliance Limited. They conducted surface work and installed a mill that in 1959 was operating at 54 tonnes per day (Northern Miner, January 18, 1973). In 1962 the claim was transferred to J.C.L. Ferguson. Between 1962 and 1964 the mine produced a small amount of gold (Manitoba Mines Branch, Corporation File, Crowduck Bay Mines Prospectus, 1974).

In 1973 Ferro was assigned to Crowduck Bay Mines Ltd. who carried out an underground sampling program and began mining a small open pit. Indicated reserves were estimated at 36 284 tonnes averaging 9.43 g/tonne (0.28 oz/ton) gold, plus 4536 tonnes of surface material that averaged 8.57 g/tonne (0.25 oz/ton) gold (Canadian Mines Handbook,

1973-74). The mill was rehabilitated and operated sporadically until September 1974.

In 1979 Norman Mines gained an interest in the property and retained Prospection Limited to carry out a technical evaluation of all prior work on the Ferro property. Based on Prospection's recommendations Norman Mines initiated underground rehabilitation, mapping, chip sampling and sidewall sludge sampling. Surface work included mapping, geophysical surveys and diamond drilling. The results of this exploration are not known. Ownership of the Ferro property was transferred to Patrick Harrison Co. Ltd. in 1983.

Rainbow Group — The property was first staked in 1923. Several individuals and companies held the property in the 1920s and early 1930s including: A. Damour, A. Chartrand, and M.J. Hackett, The Mining Corporation of Canada, Limited and Hackett Gold Mining Company Limited. By 1931 about 549 m of stripping had been done and 45 tonnes of ore that was milled produced 0.93 kg (30.0 oz.) gold. The North British Mining and Milling Company, Limited optioned the claims in 1932. J.H.C. Waite optioned the property in 1935 and drilled 8 holes. The option was subsequently dropped.

Wekusko Consolidated Limited optioned the property in 1943 and by the end of 1944 had drilled at least 18 holes on Rainbow. Several of these holes averaged more than 6.86 g/tonne (0.2 oz/ton) gold across widths greater than 1.5 m (Wekusko Consolidated Limited, 1944 Annual Report). The following year four levels of the Ferro mine were driven onto the Rainbow claim. Following is a summary of the assay results from samples taken from the drifts:

Level	Length (m)	Width (m)	Grade g/tonne (oz/ton) gold	
1	25.93	1.40	14.40	(0.42)
2	27.36	0.95	11.66	(0.34)
3	15.25	0.95	8.57	(0.25)
3	9.2	0.92	8.91	(0.26)
3	6.41	0.92	10.97	(0.32)

Source: Wekusko Consolidated Limited, 1947 Annual Report.

Exploration was discontinued in January 1948.

Patrick Harrison and Company Limited acquired the claims in 1980 and later in the same year transferred ownership to Norman Mines Limited.

History of Production:

Year	Tonnes milled	Gold produced kg (oz.)	
1932	1005.8	16.28	(523.51)
1933		6.44	(207)
1962-64		3.73	(120)
1973-74	?	?	
Total		26.45	(850.51)

Sources: Manitoba Mines Branch, Corporation File, Crowduck Bay Mines Ltd., Canadian Mines Handbook 1934

Selected Bibliography: Bailes (1971); Davies et al. (1962); Harrison (1951a); Manitoba Mines Branch, Corporation File (Crowduck Bay Mines, Explorers Alliance Limited, Mining Corporation of Canada, Norman Mines Limited, North British Mining Company, Wekusko Consolidated Limited), Mineral Inventory File (63 J/13SE Au1); Stockwell (1937); Wright (1931).

Moose Horn (Ballast)

Location: 20 km southeast of Snow Lake, on the east shore of Wekusko Lake.

Map Reference: Map ER86-1-3, location FF5.

Description of Deposit:

The deposit consists of a gold-bearing quartz vein that occurs within sheared quartz-feldspar porphyry. The vein strikes 035 , dips 65 to the southeast, averages 0.45 m in width and consists of white coarsely granular quartz. Mineralization consists of arsenopyrite, pyrite, chalcopyrite, galena, sphalerite, free gold and petzite.

History of Exploration and Development:

In 1914 R.A. Hazelwood and H. Vickers staked the Ballast and Moose Horn claims. Northern Manitoba Mining and Development Company, Limited was organized in 1915 to develop the property. In 1917, 26 tonnes of ore shipped to Trail B.C. produced 3.4 kg (108 oz.) of gold. The Makeever brothers optioned the property in 1918. Ore sent to the Laguna mill produced 1.6 kg (52 oz.) of gold (Robinson, 1935).

In 1931 Robert Kerr mined 16 tonnes of ore that produced 1.1 kg (34.0 oz.) gold.

In 1944 the claims were optioned to Wekusko Consolidated Limited who carried out diamond drilling before allowing the option to lapse in 1945.

Since 1945 the property has been controlled by McKenzie Oil and Gas Company Limited, Donald Kish, and most recently by Peter Dunlop.

History of Production:

Year	Tonnes mined	Tonnes milled	Gold produced kg (oz.)	
1917	25.9	25.9	3.36	(108)
1918			1.62	(52)
1931	16.0	16.0	1.06	(34)
Total	41.9	41.9	6.04	(194)

Source: Robinson (1935), Manitoba Mines Branch, Annual Report on Mines and Minerals, 1931, p. 40.

Selected Bibliography: Alcock (1919); Bailes (1971); Davies et al. (1962); Manitoba Mines Branch, Annual Report on Mines and Minerals (1928, 1932), Corporation File (Kiskoba Mining Company Limited, Wekusko Consolidated Limited), Mineral Inventory File (63 J/13SW Au4); Stockwell (1937); Wright (1931).

Bingo

Location: 18 km southeast of Snow Lake, just east of Wekusko Lake.

Map Reference: Map ER86-1-3, location FF 11.

Description of Deposit

Gold-bearing quartz veins occur in quartz-feldspar porphyry. The veins strike 018 , dip 75 NW, range in width from 0.2 to 0.6 m and contain pyrite, galena, arsenopyrite, tourmaline and visible gold.

History of Exploration and Development:

The property was first staked in 1915 by J. McCormack and was assigned to J.R. Campbell one year later. Surface work was done in 1916, 1917 and 1919. Several people held interest in the claim before it was

assigned to H.R. Drummond-Hay in 1919. He assayed 6 samples that averaged 188.6 g/tonne ($110/tonne at $20/oz. gold) gold over a width of 0.15 m. Bingo Mines, Limited was formed to develop the property and from 1922 to 1944 sank a 122 m deep shaft, drove 183 m of drifts and 61 m of crosscuts (Stockwell, 1937). The company reported uniformly high gold grades were obtained from samples of the drifts and crosscuts. However, sampling done by Reid and Dresser (1924) failed to outline any economic areas of mineralization. As a result the company was accused of "salting" assay samples. The managing director of Bingo Mines, Limited was charged with making false statements and intent to defraud and was acquitted.

Bingo Mines, Limited was liquidated and its assets purchased by a new company, Bingo Gold Mines, Limited. In early 1926 a test mill was constructed and 425 tonnes of hand-cobbed ore was milled to produce 4.4 kg (128 oz.) gold. In 1927 drill holes were collared to test the veins at depth. Poor core recovery and abnormal hole flattening prevented the holes from reaching the desired depth; however, the assay results were reported to be encouraging (Manitoba Mines Branch, Corpoartion File, Bingo Gold Mines, Limited). In 1937 the mine workings were allowed to flood and the old test mill was sold.

In 1978 A.V. Harris Exploration Services acquired the property and undertook a program of linecutting and sampling of dumps. Norman Mines Ltd. acquired the property in 1980 and carried out linecutting and prospecting. In 1984, 100% interest of the property reverted back to A.V. Harris Exploration Services Ltd. who dealt it to Wekusko Lake Resources Ltd. A biogeochemical survey was carried out in May 1984. In September 1984 Noranda acquired the property as part of the Laguna-Bingo Option. Noranda undertook a program of linecutting, geological mapping, soil sampling, lithogeochemistry and geophysical surveys.

History of Production:

In 1926 the test mill produced a total of 4.4 kg (128 oz.) gold (Manitoba Mines Branch, Annual Report 1926).

Selected Bibliography: Galley et al. (1986); Reid and Dresser (1925); Manitoba Mines Branch, Mineral Inventory File (63 J/13SW Au3); Robinson (1935); Stockwell (1937), Wright (1931).

Gold Hill

Location: 39 km southeast of Flin Flon, 1.3 km southeast of Cranberry Portage.

Map Reference: Map ER86-1-3, location FF6.

Description of Deposit:

The property is underlain by granite that is cut by a series of en echelon quartz veins and lenses with associated pyrite and chalcopyrite. The veins and lenses strike 080 and dip 70 S.

History of Exploration and Development:

The property was first staked in 1934. From 1935 to 1963 the property was worked by several companies including Gold Hill Development Syndicate Limited, Myrtle Gold Mines Limited, Bergold Development Company Ltd. and Cranberry Mines Ltd. Development work carried out included: a 40 m inclined shaft, 29 m of drifting and 360 m of diamond drilling. Total production for this period was 103 tonnes averaging 20.27 g/tonne (0.59 oz/ton) gold. Recently P. Dunlop carried out linecutting, trenching and geophysical surveys.

Selected Bibliography: Manitoba Mines Branch, Corporation File (Bergold Development Company Ltd., Cranberry Gold Mine Syndicate, Limited, Gold Hill Development Syndicate.), Mineral Inventory File (63 K/11SW Au3).

Century Mine

Location: 53 km west of the town of Snow Lake.

Map Reference: Map ER86-1-3, location FF7.

Description of Deposit:

The area is underlain by Amisk Group massive and pillowed andesite flows that are intruded by quartz-feldspar porphyry. A quartz porphyry dyke, 0.92 to 3.05 m wide, was traced at intervals for a strike length of 92 m. Much of the porphyry is sheared and altered to sericite schist and contains disseminated pyrite and crosscutting veinlets and banded lenses of quartz up to 1.8 m long and 0.6 m wide. The quartz locally carries pyrite, galena, chalcopyrite and visible gold. Gold commonly occurs at the contact of quartz with altered wall rock. Patches of carbonate are also present in some of the quartz.

History of Exploration and Development:

The deposit was first staked in 1919. A 21 m shaft was sank and 24 m of development work carried out. In 1937 Century Mining Corporation deepened the shaft to 88 m and carried out 1387 m of drilling (Northern Miner, February 27, 1941).

In 1941 a 90-tonne mill was constructed but operated only until January 1942. Early in 1946 work resumed on the property. The shaft was deepened to 161 m with stations cut at depths of 114 and 153 m. In the spring of 1951 a 6-hole 2951 m drill program was completed; however, the results were never reported.

From 1955 to 1976 the property was held by A.D. MacPherson, Fairfield Projects Limited and Marwil Industries Ltd.

In 1979 Ram Petroleums Limited obtained an option on the property and carried out geological, geochemical, and geophysical surveys that indicated extensions of the known veins. Diamond drilling was carried out and indicated proven reserves of 272 000 tonnes grading 12.0 g/tonne (0.35 oz/ton) gold in the Webb-Garbutt zones (Ram Petroleums Limited, Interim Report, September 30, 1980).

History of Production:

The only recorded production was in 1942 when a gold bar weighing 1.85 kg (59.6 oz.) was produced.

Selected Bibliography: McGlynn (1959); Manitoba Mines Branch, Corporation Files, Century Mining Corporation; Mineral Policy Sector, Ottawa, Corporation File (Century Mining Corporation, Elbow Lake Mining Syndicate Limited, Golden West Mines Limited, Ram Petroleums Limited), Mineral Inventory File (63 K/15SW, Au4).

GOLD DEPOSITS

Tartan Lake

Location: 13.5 km northeast of Flin Flon.

Map Reference: Map ER86-1-3, location FF8.

Description of Deposit:

The following description is summarized primarily from Peloquin et al. (1986). The area is underlain by several phases of dioritic to gabbroic rocks that intrude Amisk Group basalt to andesite flows and pyroclastic rocks *(Fig. 30)*. The Tartan Lake deposit consists of two gold-bearing shear zones: the Main zone and the South zone. The Main zone does not outcrop; however, the South zone is well exposed and is characterized by a central zone of chlorite-carbonate-quartz fuchsite tourmaline sericite schist, a marginal zone of weakly schistose chlorite-carbonate-

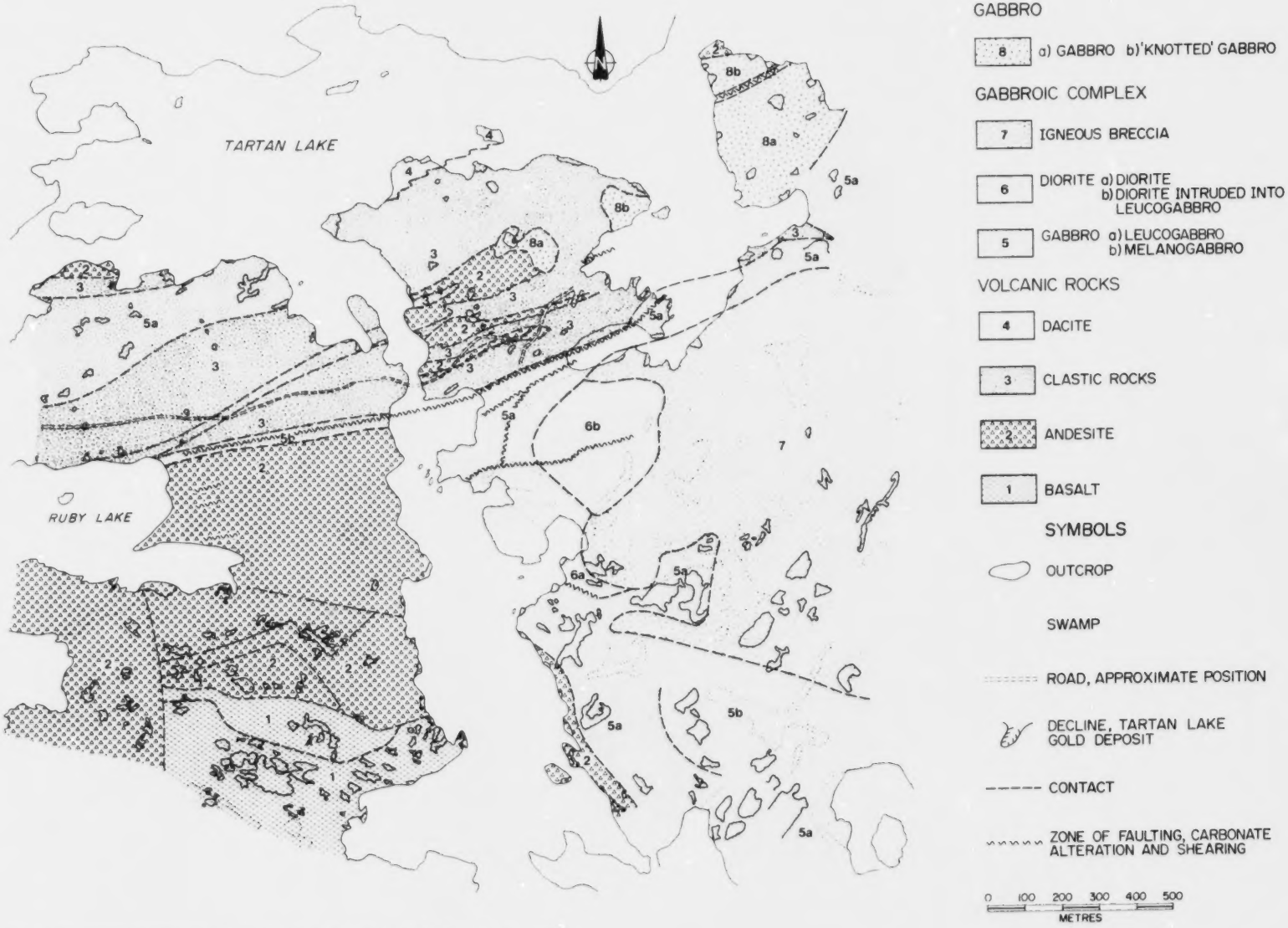


Figure 30. General geology of the Tartan Lake area (from Peloquin et al., 1986).

quartz and an outermost zone of pale green schistose to weakly schistose chloritic rock. Fine grained massive gabbro with weak carbonate alteration is found at the margins of the shear.

Most of the property's reserves are confined to the Main zone shear and consist of two gold-bearing lenses that strike 090 , dip steeply to the north and plunge steeply west to northwest (Northern Miner, January 20, 1985; Kreczmer and Deveaux, 1986). Lens number 1 has a strike length of 60 m and extends vertically to the 90 m level. Lens number 2, which is located 5-10 m on the footwall side of lens 1, has a strike length near surface of 40 m, increasing to 200 m on the 200 m level.

History of Exploration and Development:

The property was first staked in 1931, as the Killarney and Monica claims. The following year Consolidated Mining and Smelting Company of Canada (Limited) did surface work on the west side of the property. Samples yielded assays that ranged from 3.09 g/tonne (0.09 oz/ton) gold over 4.58 m to 171.78 g/tonne (5.01 oz/ton) gold over 0.31 m.

Nesnah Mining and Exploration Company Limited took an option on the property in 1945. Drilling outlined possible reserves of 207 tonnes per vertical metre grading 19.20 g/tonne (0.56 oz/ton) gold (Manitoba Mines Branch, Corporation File, Nesnah Mining and Exploration Limited). The Killarney and Monica claims lapsed in 1960 and 1971, respectively.

The area was restaked by J. Murray and A.T. Jacobson in the 1960s and 1970s; however, little exploration was done and the claims lapsed.

Granges Exploration Aktiebolag staked the property in September 1981. Diamond drilling confirmed a zone of gold mineralization over a strike length of 183 m to a vertical depth of 122 m. The discovery hole intersected 16.84 m averaging 20.78 g/tonne (0.61 oz/ton) gold (Granges Exploration Aktiebolag, News Release, November 26, 1984). In 1985, in joint venture with Abermin Corporation, Granges carried out delineation drilling that indicated a deposit with reserves of 465 000 tonnes grading 11.97 g/tonne (0.349 oz/ton) gold (Granges Exploration Ltd., Annual Report, 1985).

In 1986 the joint venture partners carried out an underground development program consisting of: driving an exploration decline, underground drilling for stope definition and surface drilling of the South zone *(Fig. 31)*. Based on the results of underground drilling the joint venture started construction of a 450 tonne per day modular mill that will

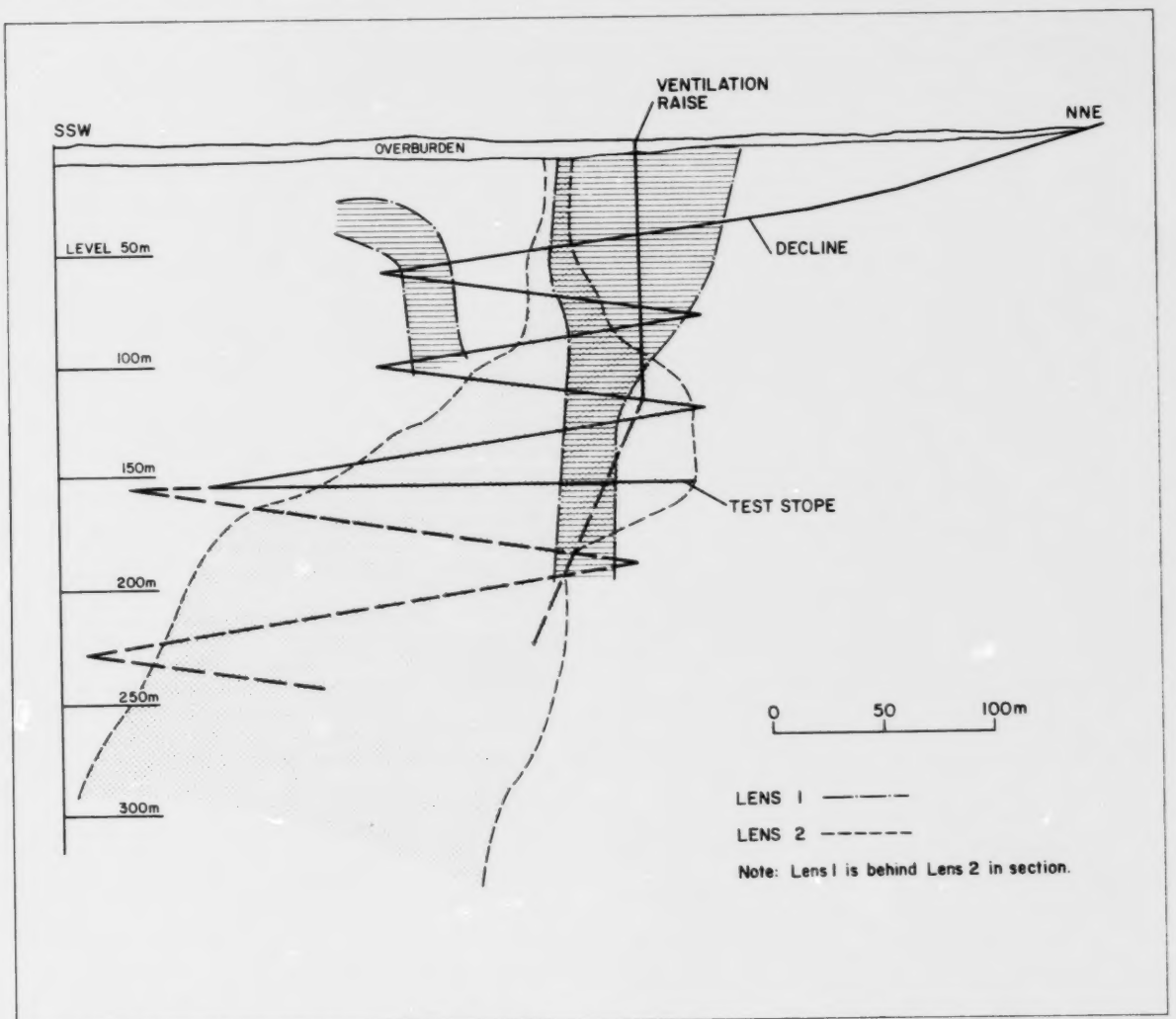


Figure 31. Schematic section of mine development of the Tartan Lake main zone (from Northern Miner, March 10, 1986).

Figure 32. Aerial view of the Tartan Lake property (April 1987).

likely be producing at an initial rate of 225 tonnes per day by late March 1987 (Northern Miner, January 12, 1987, p. 1). When in full production the mine will produce 1555 kg (50 000 oz.) of gold annually.

Selected Bibliography: Gale (1981); Kreczmer and Deveaux (1986); Manitoba Mines Branch (Corporation File, Nesnah Mining and Exploration Company Limited); Mineral Inventory File (63 K/13 Au2); Peloquin and Gale (1985); Peloquin et al. (1986).

Apex

Location: 15.5 km southeast of Snow Lake, on a peninsula separating Herb Bay and Crowduck Bay of Wekusko Lake.

Map Reference: Map ER86-1-3, location FF9.

Description of Deposit:

The area is underlain by Post-Missi Intrusive Group granodiorite. Gold, sulphide and tungsten-bearing quartz stockworks fill fractures and shears in the granodiorite. At surface the mineralized area is hook-shaped and is 260 m long and averages 10 m wide. Arsenopyrite is the predominant sulphide and may constitute up to 10% of the stockworks over narrow widths. Visible gold and lenses of scheelite occur locally.

History of Exploration and Development:

The property was first staked in 1918. Various prospectors held the property until The Mammoth Mining Corporation Limited acquired the property in 1920. J.A. Reid, a consulting geologist, visited the property in 1923 and took over 900 samples (Manitoba Mines Branch, Corporation File, Mammoth Mining Corporation Limited). The best zone of mineralization averaged 16.46 g/tonne (0.48 oz/ton) gold over an average width of 2.75 m and length of 36.6 m. A 4.6 m shaft was sank on Apex in 1927.

In 1930 Consolidated Mining and Smelting Company of Canada Limited took approximately 540 channel samples across 1.5 m widths. Based on 816 kg of assayed samples they estimated that the deposit contained 758 000 tonnes grading 3.63 g/tonne (0.11 oz/ton) gold. The company planned to carry out diamond drilling; however, problems arose in negotiating an option agreement and drilling was not carried out.

Fifty-Three Syndicate Limited was formed in 1934 to examine the property and develop it. They carried out diamond drilling but did not intersect mineralization similar to that exposed in outcrop.

R. Kerr restaked the property in 1940. Tungold Mines Limited explored the claims for tungsten and in 1942 discovered scheelite in the former gold workings. A hand-cobbed 1115 kg sample assayed 7.54 g/tonne (0.22 oz/ton) gold and 46.64% WO_3. From 1943 to 1946 Tungold carried out a 77-hole 2711 m drill program. Of the first 52 holes drilled, 33 contained significant gold mineralization but scheelite grades were disappointing. Tungold planned to carry out a deep drilling program to test the deposit at depth; however, financing of the project was never completed and the claims were cancelled in 1955.

The property, although staked three times from 1956 to 1973, was not explored.

In 1973 W. Bartum Kobar staked the property. A&V Harris Exploration Services acquired the property in 1979 and optioned it to Placer Development Limited in 1980. Placer carried out 16 km of linecutting, detailed mapping, sampling and 517 m of drilling before dropping the option. Nord Resources reportedly optioned the property and in 1981 contracted San Francisco Mining Associates to carry out an 11-hole 915 m drill program. Results of the program are not known.

Selected Bibliography: Alcock (1919); Bailes (1971); Little (1959); Manitoba Mines Branch, Annual Reports on Mines and Minerals (1941, 1944), Corporation File (Consolidated Mining and Smelting Company of Canada Limited, Mammoth Mining Co Ltd., Tungold Mines Ltd), Mineral Inventory File (63 J/13SW, Au11); Reid (1923); Shepherd (1943).

Snow Lake Mines Ltd. Property

Location: 1.5 km northwest of Snow Lake.

Map Reference: Map ER86-1-3, location FF10.

Description of Deposit:

The following description is summarized primarily from Galley et al. (1986). The property is underlain by three northwest-striking units: 1) a northern unit comprising massive to pillowed flows that are crosscut by numerous diorite intrusions; 2) a central unit of mafic fragmental rocks and flows; and 3) a southern zone of felsic quartz-phyric tuff and lapilli tuff, intruded by hornblendite dykes and sills. These units represent a complexly faulted homoclinal sequence that strikes northwest and dips to the northeast.

There are several mineralized zones on the property; however, the No. 3 zone and Birch zone are the largest. The No. 3 zone occurs in heterolithic fragmental rocks, is 2 to 11 m thick, has economic grades proven over a length of 200 m and extends down dip at 45 for 100 m. The zone is characterized by numerous faults, erratic thicknesses and a quartz vein stockwork. The faults and mineralized zone are curvilinear striking 285 at the northwest extremity and 080 at the eastern extremity. Mineralization consists of up to 10% arsenopyrite, 0-5% pyrite and up to 5% tourmaline. High-grade zones are composed of felted masses of arsenopyrite along the margins of quartz veins and locally contain visible gold. Hudson Bay Mining and Smelting Co., Limited estimate drill indicated reserves of the No. 3 zone at 200 000 tonnes grading 15.09 g/tonne gold (Northern Miner, April 28, 1986).

The Birch zone, which is located 1.2 km north-northwest of the No. 3 zone, has a strike length in excess of 120 m and downdip extent in excess of 180 m (Northern Miner, March 9, 1987). Drill results indicate the presence of at least 127 000 tonnes averaging 18.1 g/tonne (0.528 oz/ton) gold over an average width of 1.98 m.

History of Exploration and Development:

The property was first staked in the early 1940s by various individuals including: C.R. Parres, G. Richard and H. Vickers. Nor-Acme Gold Mines Limited acquired the property in 1942 and then sub-leased it to the Howe Sound Exploration Company, Ltd. The lease was cancelled on November 17, 1964.

From 1964 to 1971 the property was held by various individuals. During this period geophysical surveys were completed.

In 1971 W. Bruce Dunlop Limited (NPL) staked the property. Granges Exploration Aktiebolag optioned the property in 1980 and carried out linecutting and geophysical surveys over the property. Granges dropped the option and in subsequent agreements the property was transferred to Darius Gold Mine Inc. in 1982, and then to Gold Fields Canadian Mining Limited in late 1982. Gold Fields carried out further linecutting and geophysical surveys followed by 16 140 m of diamond drilling. In June 1985 HBM&S optioned the property and carried out a 47-hole 3406 m drill program. The option lapsed in early 1986.

In March 1986 Silver Hart Mines Ltd acquired 100% interest in the property, subject to a 3.5% net smelter return on the three principal claims and 1% net smelter return on the balance. Snow Lake Mines acquired the property in late 1986 and commenced diamond drilling in early 1987. In March they announced the discovery of the Birch zone.

Selected Bibliography: Harrison (1949); Galley et al. (1986); Gonzales and Fedikow (1984).

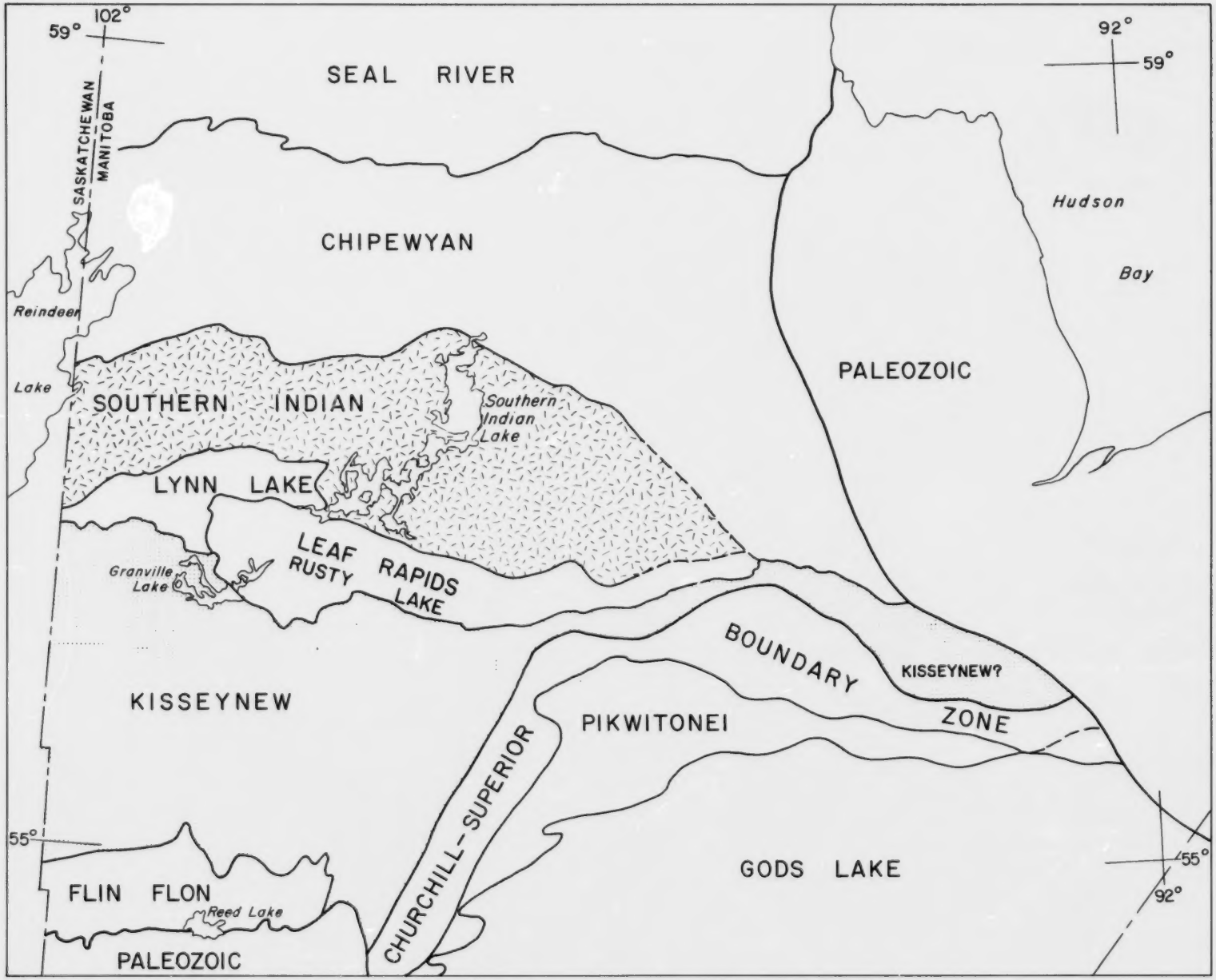


Figure 33. Geological subprovinces of the Churchill Structural Province and adjacent Superior Structural Province (after Zwanzig et al., 1985).

LYNN LAKE GREENSTONE BELT

REGIONAL GEOLOGY

Introduction

The early Proterozoic Lynn Lake greenstone belt is situated in the Churchill Structural Province of the Canadian Shield. The Aphebian volcano-sedimentary rocks of the Lynn Lake belt form two major laterally continuous northeast-trending belts and several smaller variably trending belts that are separated by large areas of mafic to felsic plutons (Map ER86-1-3, in pocket). It is bounded to the north by the Southern Indian sedimentary gneissic belt, to the east by the Rusty Lake greenstone belt and to the south by the Kisseynew sedimentary gneissic belt *(Fig. 33)*.

The Lynn Lake belt comprises volcanic and derived sedimentary rocks of the Wasekwan Group (Bateman, 1945), and the unconformably overlying terrestrial conglomerates and sandstones of the Sickle Group (Norman, 1934). Recent U/Pb dates from zircons (Baldwin et al., 1985) favour an Aphebian age for the Wasekwan volcanic rocks (1910 +15/-10 Ma) and post-Wasekwan, pre-Sickle intrusions (1876 +6/-4 Ma).

Wasekwan Group

The most extensive areas of Wasekwan Group rocks are two northeast-trending belts, the Northern Belt and Southern Belt (Gilbert et al. 1980; Map ER86-1-3). Smaller belts of Wasekwan Group rocks occur in the Counsell Lake, Miskwa Lake and Durand Lake areas.

The Northern Belt has been traced for over 100 km from Motriuk Lake northeast to Barrington Lake and then east to Magrath Lake. It is dominated by mafic volcanic rocks that are intercalated with subordinate felsic volcanic rocks and locally with intermediate volcanic rocks. The mafic volcanic rocks comprise tholeiitic basalt and andesite interlayered with high-alumina basalt and andesite (Gilbert et al. 1980). The stratigraphic sequence is divided into six subdivisions that are, from oldest to youngest:

Division A — rhyolite pyroclastic rocks and flows
Division B — high-alumina basalt, basalt, andesite and rhyolite
Division C — dominantly turbiditic sedimentary rocks
Division D — high-alumina basalt, basalt and high-magnesian basalt
Division E — basalt tuffs, flows, breccia and volcanogenic sediments
Division F — rhyolite flows, breccia, greywacke and tuff.

The Southern Belt extends for over 150 km from Laurie Lake in the west to Opachuanau Lake in the east and is composed of lens-shaped units of volcanic and sedimentary rocks. The oldest rocks are primitive calc-alkaline and tholeiitic basalts that form a thick platform or substrate (Gilbert et al., 1980; Syme, 1985a). In the eastern part of the Southern Belt from McVeigh Lake to Hughes Lake the platform basalts, tholeiitic Cockeram Lake aphyric basalt and McVeigh Lake porphyritic basalt, are overlain by:

1) a lens of felsic volcanic and related volcaniclastic rocks called the Fraser Lake rhyolite
2) a 1200 m thick succession of rhyolite, greywacke, conglomerate and siltstone in the Fraser Lake-Eldon Lake area; and
3) a calc-alkaline sequence in the Hughes Lake and Cockeram Lake-Pole Lake area comprising basalt and andesite flows and minor rhyolite, greywacke and siltstone.

In the Hughes Lake area the calc-alkaline suite is overlain by tholeiitic aphyric basalt, basal conglomerate and fine grained sedimentary rocks, and intermediate and felsic tuffs. In the Gemmell Lake area, near the stratigraphic top of the succession, mafic rocks are intercalated with felsic volcanic rocks, tuffs, fine grained sedimentary rocks and iron formation.

In the Fox Mine to Wilmot Lake portion of the Southern Belt the Fox Lake porphyritic basalts are the oldest rocks and form a platform that is considered to be equivalent to the McVeigh Lake and Cockeram Lake basalts in the northeastern part of the Southern Belt. They are overlain by four units that are, from oldest to youngest:

1) felsic volcanic rocks called the Snake Lake dacites that comprise several thick lenses of massive flows or thin discontinuous layers of tuffs and flows;
2) a heterogeneous assemblage of aphyric basalt, porphyritic basalt and andesite and fine grained sedimentary rocks called the Fox Mine succession;
3) a sequence of fine grained and conglomeratic greywacke called the Fox Road turbidite; and
4) the Wilmot Lake volcanic and sedimentary rocks, the youngest unit, composed of porphyritic basalt, andesite breccia and tuff.

In the Laurie Lake-Tod Lake area the oldest rocks comprise greywacke, mudstone and siltstone. They are overlain by the Tod Lake aphyric, high-magnesium basalts.

The smaller volcanic belts comprise porphyritic and aphyric basalt overlain by siltstone, ferruginous chert, felsic tuff, mafic mudstone and biotite-bearing greywacke.

Pre-Sickle Intrusions

Large composite plutons of diorite, tonalite, granodiorite and granite underlie the area between the Northern and Southern Belts. In addition, the Wasekwan Group is intruded by isolated plutons of gabbro, norite and minor ultramafic rocks. Similar composite plutons separate the smaller volcanic belts.

Sickle Group

The Sickle Group comprises a thick sequence of sandstone and conglomerate that unconformably overlies Pre-Sickle intrusive rocks and Wasekwan Group rocks in the central and southern parts of the Lynn Lake belt, respectively (Gilbert et al., 1980). In the Hunter Lake-Sickle Lake and Hughes Lake areas Sickle Group rocks outcrop in northand east-trending basin structures that comprise a lower conglomeratic unit with clasts of quartz-feldspar porphyry, granodiorite, arkose, mafic and felsic volcanic rocks, chert, iron formation and epidosite overlain by an arkosic sequence of medium grained sandstone and minor pebbly sandstone.

Post-Sickle Intrusions

Post-Sickle intrusions range in composition from gabbro to granite and occur at Laurie Lake, Burge Lake and north of the Northern Belt. The Burge Lake granite, considered to represent the youngest intrusive event in the Lynn Lake belt, yields a Rb/Sr age of 1765 100 Ma (Clark, 1980).

METAMORPHISM

The grade of metamorphism of Wasekwan Group and Sickle Group rocks ranges from upper greenschist to upper amphibolite facies. Upper greenschist facies mineral assemblages are developed in the Cartwright Lake-Hughes Lake area and locally in the Northern Belt. The metamorphic grade increases west of Cartwright Lake to the greenschist-amphibolite facies transition. Low to middle amphibolite facies metamorphism developed throughout the Northern Belt, in the western part of the Southern Belt and in the Miskwa Lake Belt. Upper amphibolite facies mineral assemblages are developed in the Fox Mine area.

STRUCTURE

Gilbert et al. (1980) recognized five periods of deformation including three phases of folding. East- and northeast-trending folds (F_1) formed in Wasekwan Group rocks of the Southern Belt during D_1 deformation. The western part of the Northern Belt is considered to be a monoclinal sequence that faces north. In the eastern part of the Northern Belt the Wasekwan Group is folded by arcuate east- to southeast-trending folds (F_1?).

Uplift, faulting and tilting accompanied by the intrusion of Pre-Sickle plutons occurred during D_2 deformation. Both D_1 and D_2 structures in Wasekwan Group rocks are truncated at the unconformity with overlying Sickle Group rocks.

Thrusting occurred along the belt margins during D_3 deformation. During D_4 deformation northeast-trending F_2 folds were produced in conglomerates to the north of the Northern Belt. North- and east-trending synclines (F_2) formed basins of Sickle Group rocks at Hughes Lake, Sickle Lake and Conglomerate Lake. Elsewhere F_1 folds in the Wasekwan Group became appressed during D_4. An extensive zone of faulting,cataclasis or shearing developed along the south margin of the Southern Belt. The zone extends from Franklin Lake east to One Island Lake along the contact between the relatively brittle Pre-Sickle Series intrusives and the more ductile units of the Wasekwan Group and was referred to as the "Johnson Shear Zone" by Bateman (1945) and Milligan (1960). During D_5 deformation open cross-folding (F_3) and north- to north-east-trending faults were produced.

MINERALIZATION

Introduction

In the Lynn Lake belt gold deposits and occurrences are predominantly associated with volcanic and sedimentary rocks. Ten occurrences and two deposits are located on Map ER86-1-3.

Northern Belt

At present, the Northern Belt is known to contain two significant deposits, the MacLellan Mine and the Farley Lake deposit (Map ER86-1-4, locations 1,2). Both are hosted by a stratigraphic sequence of characteristic rock units within the Wasekwan Group called the Agassiz Metallotect (Fedikow, 1983). The metallotect comprises a unique, well defined sequence of rocks that may include basaltic-ultramafic komatiites, siliceous and biotite-rich siltstones, locally sulphidic and oxide, sulphide, and silicate facies iron formation (Fedikow, 1986a; Fedikow, 1986c). This sequence of rocks forms a stratigraphically continuous unit that can be traced from Dot Lake eastward to Barrington Lake, a distance of 65 km *(Fig. 34)*. In 1986 mapping carried out in the Spider Lake area (Fedikow, 1986b) and in the Sheila Lake-Margaret Lake area (Ferreira, 1986a) located stratigraphic sequences that extend the Agassiz Metallotect to Spider Lake in the east and westward to at least Motriuk Lake.

Host Rocks:

Mineralization at the MacLellan Mine is divided into a series of zones that are hosted by thinly bedded and interlayered siltstone, iron formation and basaltic-ultramafic komatiites (Fedikow, 1986a). Within these zones the favoured host rocks to mineralization are biotitic and siliceous siltstones; the highest ore grades are related to carbonate-quartz-sulphide veins and their silicification haloes. At Farley Lake mineralization consists of gold-bearing sulphides that have replaced magnetite laminae and grains of oxide facies iron formation. The gold-bearing sulphidized laminae form zones that are oblique to layering.

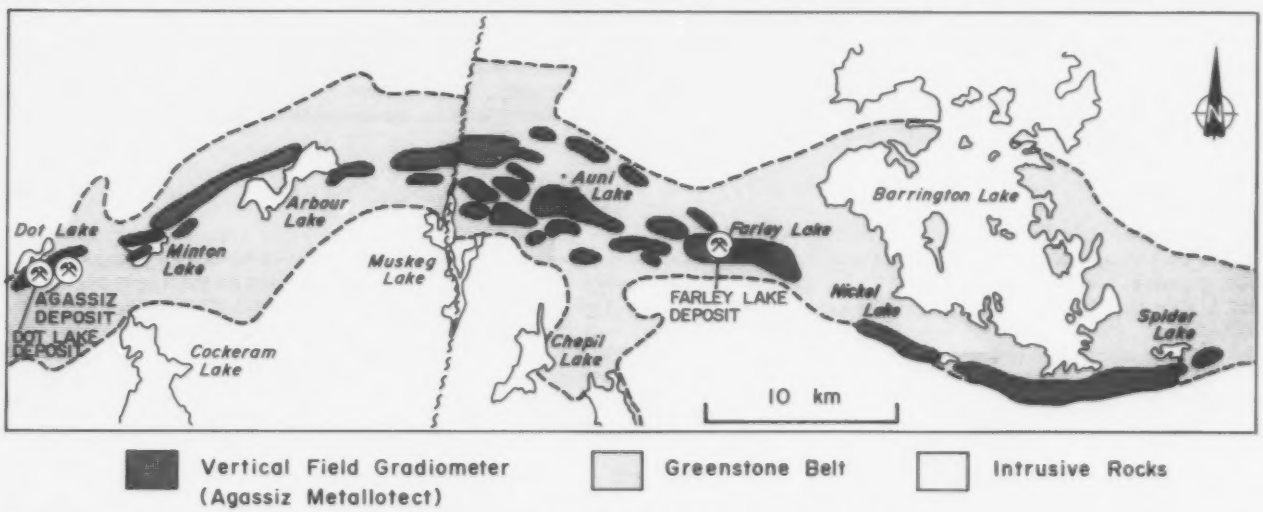


Figure 34. Airborne input and gradiometer signature of the Agassiz Metallotect (from Fedikow, 1986).

Ore Mineralogy:

Mineralization at the MacLellan Mine consists of iron sulphides with minor arsenopyrite, sphalerite, galena and rare chalcopyrite. Augsten (1985) found that the gold occurs as: 1) grains less than 30 microns in size associated with pyrrhotite, arsenopyrite, galena, pyrite, sphalerite, ilmenite and magnetite; 2) small irregular veinlets less than 10 microns in silicate host rocks; or 3) mantling rims or fracture fillings in galena, arsenopyrite and pyrrhotite.

At Farley Lake the gold and sulphide-bearing iron formation consists of magnetite/pyrrhotite and chert laminae. Gold occurs within the magnetite/pyrrhotite laminae as isolated grains in cavities in the silicate matrix and within pyrrhotite and magnetite grains (Manitoba Mineral Resources Ltd., internal report, 1986).

Genesis:

Fedikow (1986a) proposed that mineralization at the MacLellan Mine was syngenetic and subsequent deformation resulted in mobilization of the mineralization into fracture fillings and veins. Manitoba Mineral Resources Ltd. and Hudson Bay Exploration and Development Company Limited geologists believe that textures observed in drill core, and the oblique attitude of the deposits and the enclosing alteration zones to layering, support an epigenetic-replacement origin for the Farley Lake deposit.

Southern Belt

Of the eight deposits and occurrences in the Southern Belt (Map ER86-1-4, *Fig. 35)*, the Cartwright Lake (location 7), Johnson Shear (location 5), T1A Zone (location 14), CL Group (location 8), Ace Vein (location 10) and Austin Vein (location 9) occur within or adjacent to the the Johnson Shear Zone. The remaining two occurrences include the Gemmell Lake occurrence (location 6) and the Caimito Group showing in the Laurie Lake area (location 11).

Host Rocks and Nature of Mineralization:

The Cartwright Lake deposit and CL Group occurrences consist of quartz and sulphide fracture fillings within a quartz-feldspar porphyry dyke and albitite felsic intrusion, respectively. The mineralization comprises pyrite, pyrrhotite, arsenopyrite, galena and sphalerite. The gold is associated with sulphides and occurs as microscopic grains and rarely as coarser grains visible to the unaided eye.

The Johnson Shear and Ace Vein occurrences are characterized by quartz veins up to 35 cm wide that occur within volcaniclastic sedimentary rocks. Mineralization consists of massive clots as well as 2-5% disseminated pyrite, pyrrhotite, galena, sphalerite and chalcopyrite (Fedikow et al., 1986a).

The Austin Vein is a gold-bearing quartz-filled shear within Pre-Sickle Group tonalite. Pyrite, galena and sphalerite occur as large, coarse grained, massive clots in shattered quartz veins.

The Gemmell Lake occurrence is hosted by quartzite and mafic tuffs. Disseminated pyrite, arsenopyrite and rarely visible gold occur in the quartzite and mafic tuff.

The Caimito Group occurrence consists of a gold-bearing quartz-filled shear that occurs within plagioclase amphibolite (Stewart and Brewer, 1984). Mineralization is localized along fractures in the quartz, either adjacent to contacts with the wall rocks or adjacent to inclusions of wall rocks within the quartz. It comprises pyrite, pyrrhotite, minor chalcopyrite and rarely galena. Milligan (1960) reported that spectroscopic analysis of drill core indicated the presence of gallium.

Miskwa Lake Belt

The Lasthope deposit (Map ER86-1-4, location 3) consists of two parallel quartz veins that occur within a west-northwest-striking layered succession of quartz-feldspar porphyry, mafic tuff, quartzite, mudstone, chlorite-feldspar-quartz gneiss, magnetite-bearing quartzite and feldspathic quartzite (Baldwin et al., 1985). Mineralization occurs predominantly in the most southerly quartz vein and consists of 5% (up to 15% locally) pyrite and trace chalcopyrite.

Summary

The MacLellan Mine and the Farley Lake deposit occur within a narrow and laterally continuous stratigraphic sequence that has a strike length of approximately 65 km. The deposits show considerable differences in their character; however, a more important consideration is that the stratigraphic sequence has a number of features that are favourable for the concentration of gold. Processes that contributed to the siting of gold within this sequence include:

1) chemical sediments acted as chemical traps for gold-bearing fluids (Fedikow, 1986a).
2) the mineralized, altered and thinly bedded nature of the sequence served to focus deformation; syngenetically deposited gold-bearing sulphides were mobilized into fractures, intergranular pore spaces and along foliation planes (Fedikow, 1986a); and
3) komatiite/seawater interaction provided a source for the generation of gold-enriched fluids (Keays and Scott, 1976).

The MacLellan Mine represents Manitoba's first primary gold producer since the San Antonio Mine closed in 1968. The fact that the MacLellan deposit and the Farley Lake deposit occur within a stratigraphic sequence potentially favourable to gold deposition over a strike length of 65 km suggests that the area has a high potential for the discovery of more gold deposits.

Most of the gold deposits and occurrences of the Southern Belt and Miskwa belt are structurally controlled and are of epigenetic quartz vein type. The depositional sites for gold-bearing quartz veins are preferentially developed in competent rocks of the Wasekwan Group or felsic intrusive rocks within or close to the Johnson Shear Zone.

PRESENT PRODUCER

MacLellan Mine

Location: 6.5 km northeast of the town of Lynn Lake.

Map Reference: Map ER86-1-4, location 1.

Description of Deposit:

The following decription is summarized primarily from Fedikow (1986a, 1986c). The immediate footwall and hangingwall rocks to mineralization are 3-8 m thick units composed of basaltic and ultramafic komatiite flows and tuffs. The mineralized zone comprises an interlayered sequence of: 1) biotite and siliceous siltstone; 2) oxide, silicate and sulphide facies iron formation; and 3) basaltic and ultramafic komatiite flows with minor tuffs that range in thickness from 1 cm to 2 m *(Fig. 36)*.

At the MacLellan deposit deformation of rocks within the Agassiz Metallotect resulted in: 1) a well developed foliation that is parallel or subparallel to bedding; 2) tight intraformational folds; and 3) carbonate-quartz and sulphide laminae that are parallel to and crosscut bedding.

The deposit can be subdivided into a laterally discontinuous series of mineralized zones *(Fig. 37)*.

Central Zone: This part of the deposit attains thicknesses of 10-20 m and is characterized by sections containing up to 1 m of 10-25%

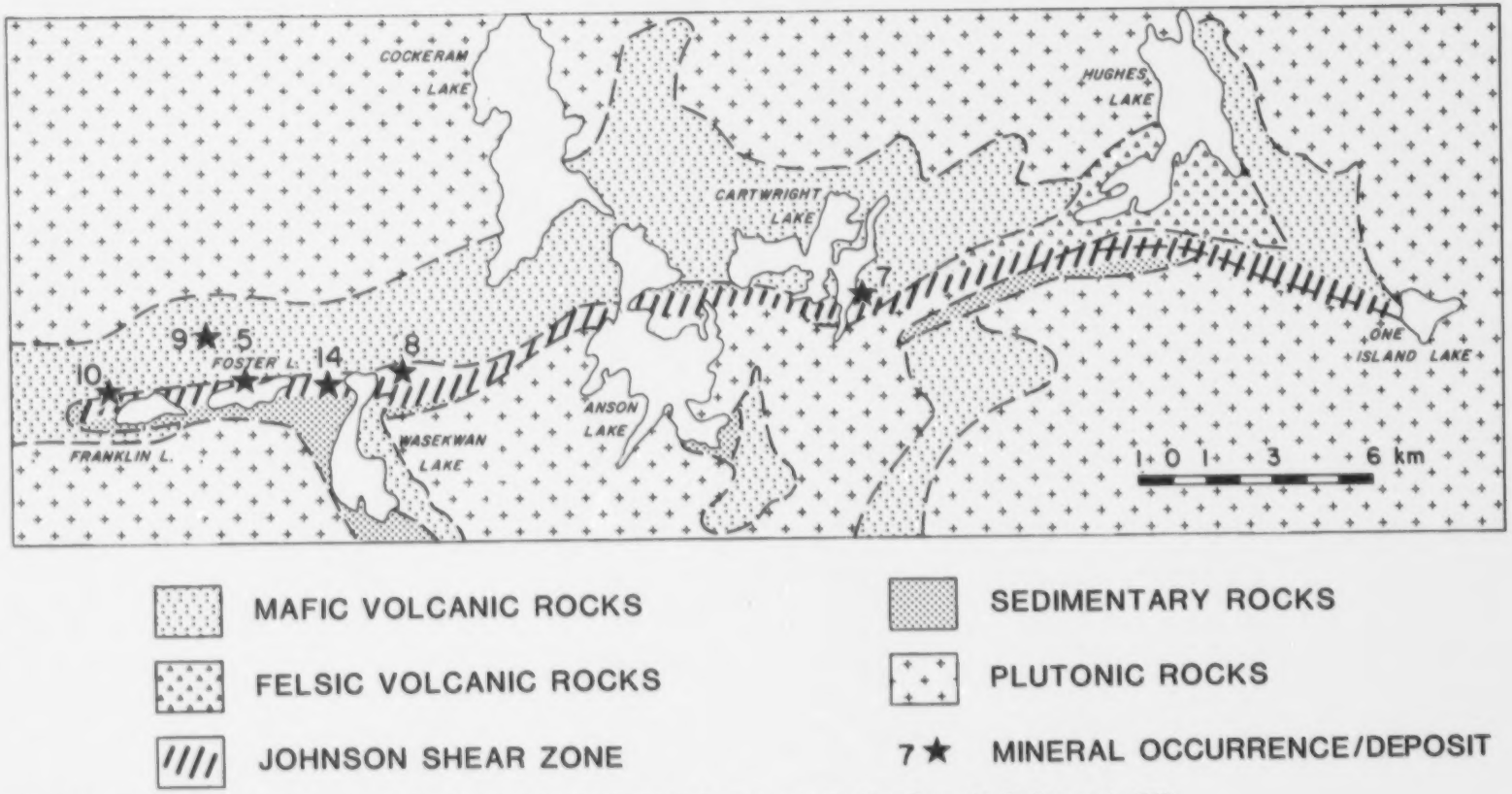


Figure 35. General geology of the Southern Belt and location of gold occurrences along the Johnson Shear Zone (after Fedikow et al., 1986).

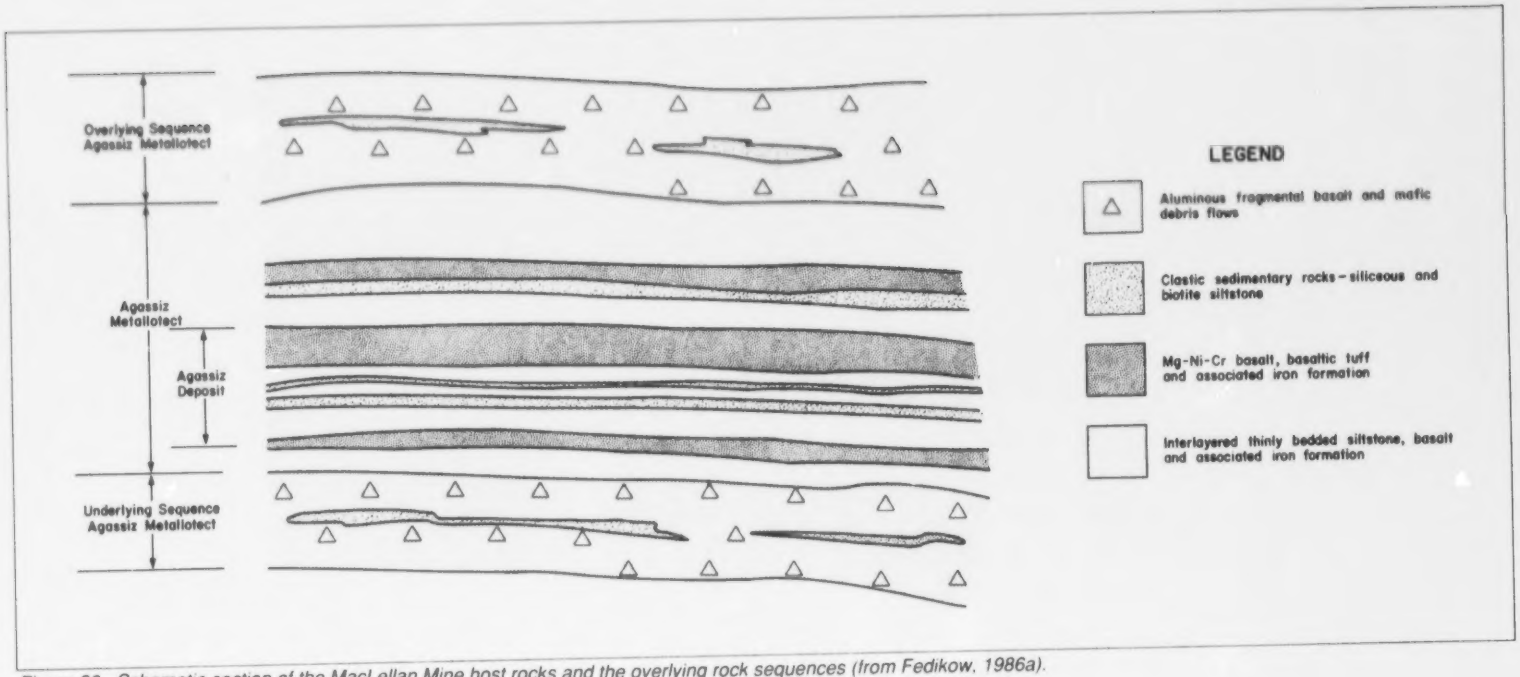


Figure 36. Schematic section of the MacLellan Mine host rocks and the overlying rock sequences (from Fedikow, 1986a).

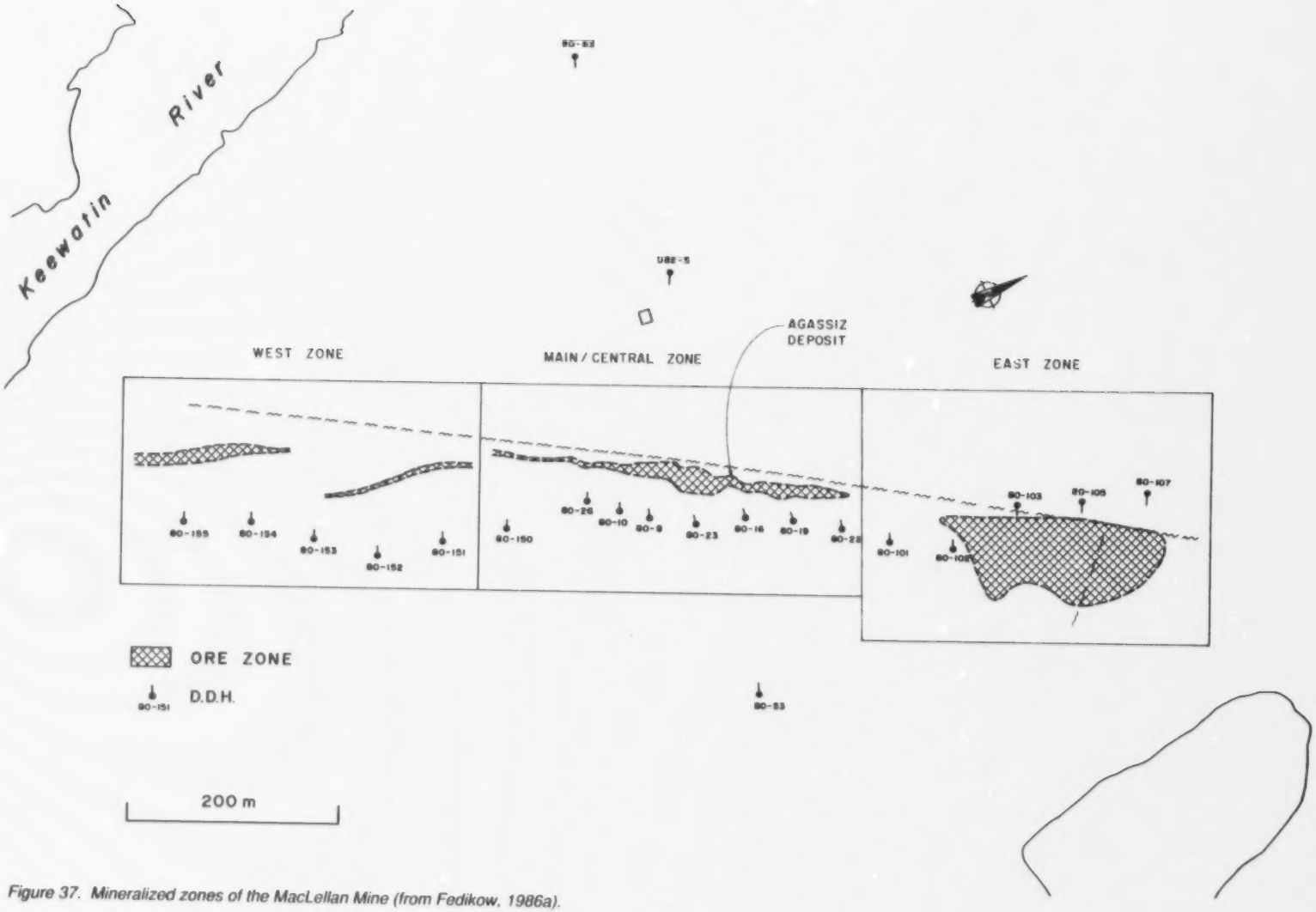


Figure 37. Mineralized zones of the MacLellan Mine (from Fedikow, 1986a).

gold-bearing iron sulphides hosted in biotite-rich and siliceous siltstone. The highest gold values are associated with carbonate-quartz-sulphide veins and their silicification haloes. Persistent but lower grade values occur in silicified and sulphide-bearing komatiites. Silicification of the siltstones and patchy but locally intense carbonate alteration of komatiites represent the most common types of alteration. Probable ore reserves of the central zone are estimated at 2.6 million tonnes averaging 5.38 g/tonne (0.157 oz/ton) (SherrGold Inc., Preliminary Prospectus, September 17, 1985).

West Zone: The geology of the West Zone is similar to that of the Central Zone; however, mineralized sections are narrower and the sulphide content is slightly lower. Visible gold occurs in association with 15% arsenopyrite, pyrrhotite, pyrite and galena in convoluted, tightly folded siltstone interlayered with basaltic and ultramafic komatiites. Possible ore reserves of the West Zone deposit are 136 000 tonnes averaging 5.49 g/tonne (0.16 oz/ton) (SherrGold Inc., Preliminary Prospectus, September 17, 1985).

East Zone: In the East Zone 30-40% disseminated iron sulphides in addition to arsenopyrite, sphalerite and galena occur as tightly folded conformable lenses within siltstone and basaltic-ultramafic komatiites. The mineralization is accompanied by locally intense carbonatization. Deformed carbonate-quartz-sulphide veins are present throughout the east zone and contain iron sulphides, arsenopyrite, sphalerite and galena. Gold is found in association with the highest concentrations of sphalerite and galena.

Dot Lake Zones: Exploration by SherrGold Inc. in joint venture with Novamin Resources Inc. has outlined geological reserves of 1.27 million tonnes averaging 4.11 g/tonne (0.12 oz/ton) gold (Kelley, 1987).

Augsten et al. (1986) carried out a detailed study of the ore mineralogy of the deposit and found that gold is present in the ore as native gold, electrum and aurian silver. The average size of gold grains is 20-30 microns although grains and veinlets greater than 150 microns were observed. The gold occurs as: 1) irregular shaped grains or veinlets of less than 10 microns in gangue, 2) rims on, or fracture fillings in galena, arsenopyrite and pyrrhotite, 3) inclusions in arsenopyrite, pyrrhotite, 4) inclusions in arsenopyrite, pyrrhotite and galena, and 5) sutured grains associated with galena.

Fedikow (1986a) acknowledged that the multiple deformational history of the host rocks makes determination of the genesis of mineralization very difficult; however, he considered that geochemical data, textures observed in diamond drill core, and thin sections studies supported an exhalative origin for the deposit. He proposed the following depositional sequence:

1) Extrusion of basaltic to ultramafic komatiites followed by deposition of clastic and sulphidic chemical sediments. The sulphidic chemical sediments acted as traps for gold released during the interaction of komatiites and seawater, and by leaching of immiscible sulphide blebs;
2) Carbonatization of the volcanic units by the reaction of iron sulphides with organic carbon;
3) Extrusion of komatiite and aluminous basalts;
4) Intraformational folding accompanied by brittle deformation focused in the mineralized zone produced tight folding and dilatant zones that enabled lateral secretion of gold-enriched sulphides, carbonate and quartz;
5) Ductile deformation produced transposed stratigraphy and diffuse alteration zones; and
6) Late brittle fractures resulted in discordant sulphide-filled fractures.

History of Exploration and Development:

The property was originally staked in 1946 by J.W. Boiley and J.G. Webb. In 1947 the claims were transferred to Roy Rundle who in turn optioned the property to Noranda Mines, Limited. Magnetometer and geological mapping surveys were conducted the same year. The option agreement was cancelled in 1948 and the claims lapsed in 1950.

In 1950, a portion of the J. J. Group was restaked as the J. R. Group of 12 claims by Roy and J. W. Rundle. Between 1950 and 1955 some trenching and test pitting was done. In April of 1955 Agassiz Mines

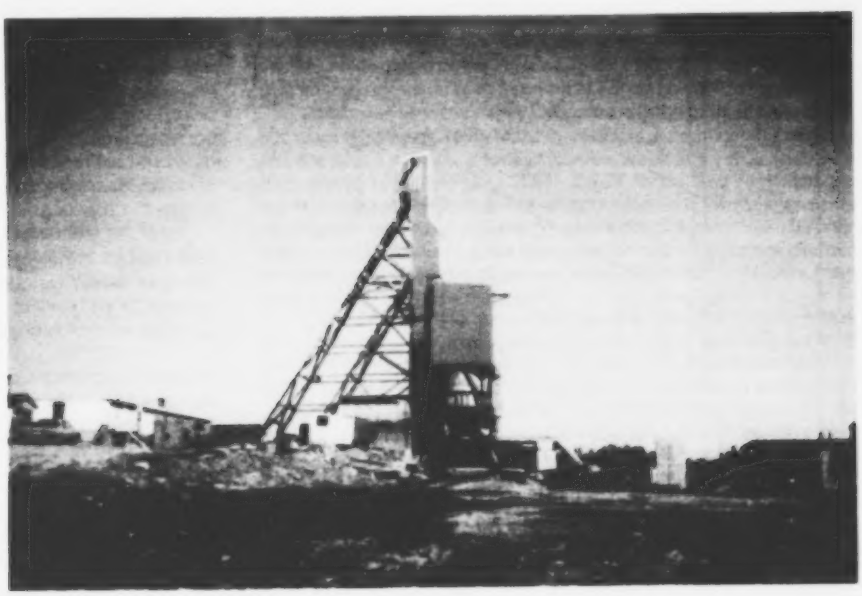


Figure 38. The MacLellan Mine headframe, Lynn Lake, Manitoba.

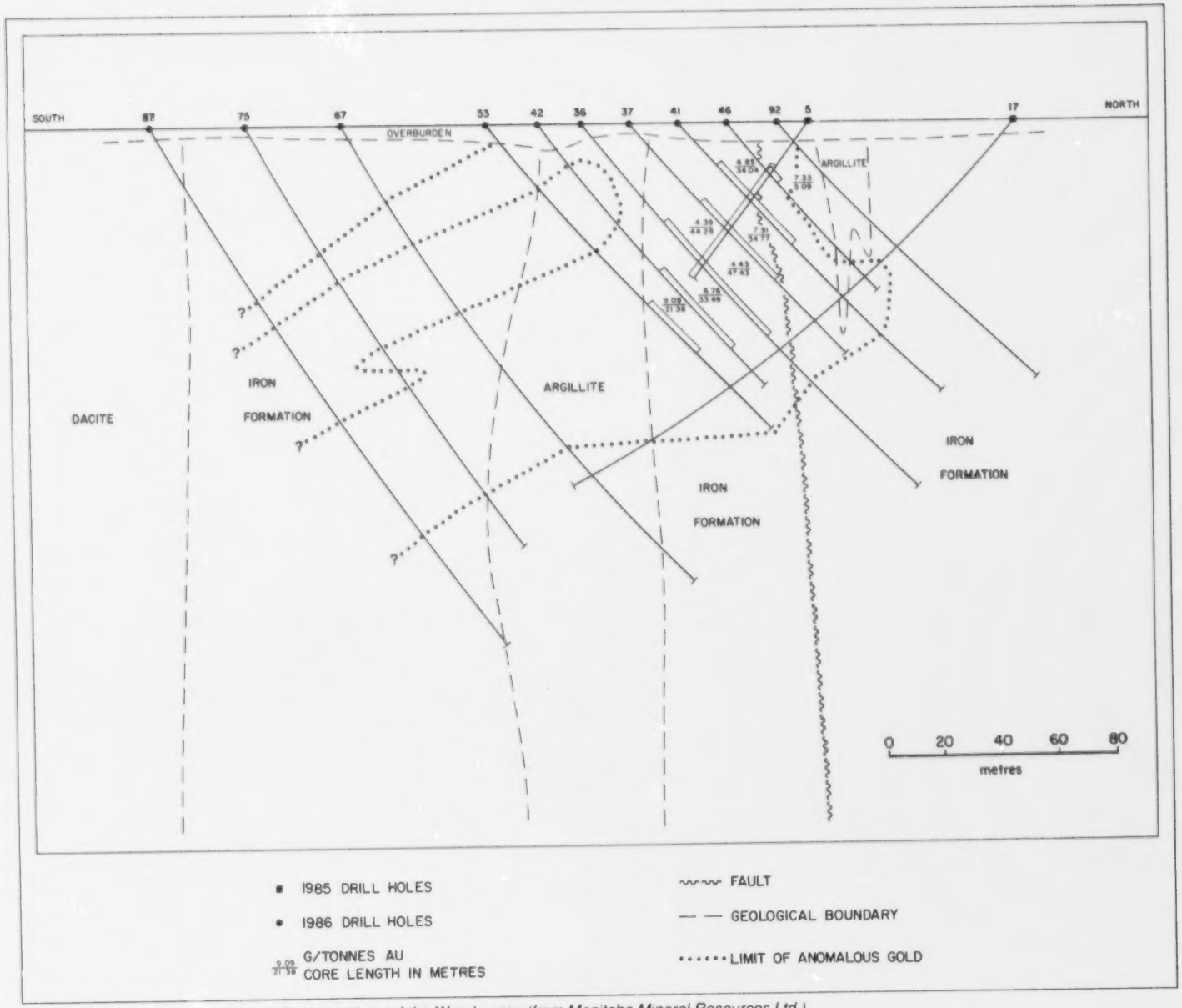


Figure 39. Cross-section showing drill intersections of the Wendy zone (from Manitoba Mineral Resources Ltd.).

Figure 40. Malcolm Wright and Mike Taylor, of Manitoba Mineral Resources Ltd. (MMR), examining Farley Lake drill core (photograph courtesy of MMR).

Limited discovered gold mineralization when samples taken from two diamond drill holes yielded low grade gold values. The claims were then optioned to Newkirk Mining Corporation Limited who assigned the claims to Aumaque Gold Mines Limited. Resistivity and EM surveys were carried out and followed up by a 21-hole drill program.

Central Manitoba Mines, Limited optioned the property in 1958. After a 2570 m drill program the option was dropped. Rayrock Mines Limited carried out a geophysical survey and prospecting in 1960.

The property remained idle until 1966. Between 1966 and 1968 Agassiz carried out 12 200 m of diamond drilling and sank a 3-compartment shaft to a depth of 137 m with levels established at 53, 98 and 137 m. In 1969 Agassiz Mines Limited became Royal Agassiz Mines Limited. By 1971, a total of 21 350 m of diamond drilling and 712 m of underground lateral work had been completed.

In 1979 the property was transferred to Comiesa Corporation who in turn optioned the property to Sherritt Gordon Mines Limited in late 1979. From 1979 to 1985 Sherritt spent in excess of $9.0 million on diamond drilling, shaft sinking and drifting to determine the size, grade and economics of the deposit. In July 1985 Sherritt announced the approval for the development of the deposit, to be called the MacLellan Mine. Kilborn Engineering (B.C.) estimated mineable ore reserves of the Main Zone to total 1.49 million tonnes grading 7.17 g/tonne (0.21 oz/ton) gold (SherrGold Inc., Preliminary Prospectus, September 17, 1985).

Sherritt arranged equity financing for development of the MacLellan Mine through subsidiary, SherrGold Inc. Development costs were also assisted by a $4 million grant from the Federal government's Canadian Jobs Strategy program and a $2 million forgivable loan from the Manitoba government.

The MacLellan Mine started production in late 1986 and is expected to be in full production (327 000 tonnes per annum mill capacity, annual production 2020 kg or 65 000 oz. gold) "early in 1987" (Kelley, 1986).

Selected Bibliography: Manitoba Mines Branch, Corporation File (Agassiz Mines Limited, Bulora Corporation Limited, Royal Agassiz Mines Limited, SherrGold Inc., Sherritt Gordon Mines Limited), Mineral Inventory (64 C/15NW, Au1); Canadian Mines Handbook (1974-75); Milligan (1960); Gilbert et al.(1980); Fedikow (1983, 1986a, 1986b, 1986c); Fedikow and Gale (1982); Fedikow et al. (1984); Nielsen (1983).

GOLD DEPOSITS

Farley Lake

Location: 40 km east of Lynn Lake.

Map Reference: Map ER86-1-4, location 2.

Description of Deposit:

The following description of the Farley Lake deposit is based mostly on personal communication with Neil Briggs of Manitoba Mineral Resources Ltd. (MMR) and Ted Baumgartner of Hudson Bay Exploration and Development (HBED).

The area is underlain by Wasekwan Group iron formation, argillite and andesite to basalt flows. These rocks are considered to represent the eastern continuation of the Agassiz Metallotect. A small quartz diorite plug intrudes these rocks to the west of Farley Lake.

Iron formation in the Farley Lake area is in the order of 6 km long by 600 m wide (Milligan, 1960, Map No. 3) and is predominantly composed of oxide facies iron formation that is intercalated with clastic sediments (Dahlstrom, 1949; Milligan, 1960). Oxide facies iron formation that outcrops west of Gordon Lake consists of laminae of hematite and chert ranging from less than 5 cm up to 15 cm in width (Stanton, 1948). Between Gordon and Farley Lake oxide facies iron formation consists of interbedded laminae of magnetite, chert and layers of chlorite, amphibole, minor silica and disseminated magnetite.

Oxide facies iron formation hosts several zones of gold mineralization. They occur as lens-shaped deposits within and subparallel to alteration zones characterized by silicification, chloritization and sulphidization; both the deposits and the alteration zones are oblique to layering *(Fig. 39)*. The gold- and sulphide-bearing iron formation consists of interbedded pyrrhotite/magnetite and chert laminae. Minor amounts of pyrite and silicate minerals are also present. The proportion of pyrrhotite in individual pyrrhotite/magnetite laminae ranges from less than 5% up to 90% and contains small isolated grains of gold in cavities in the silicate matrix and within pyrrhotite and magnetite grains (Manitoba Mineral Resources, internal report). Traces of gold and sulphides also occur in quartz veins within iron formation, argillite, mafic volcanics and quartz diorite.

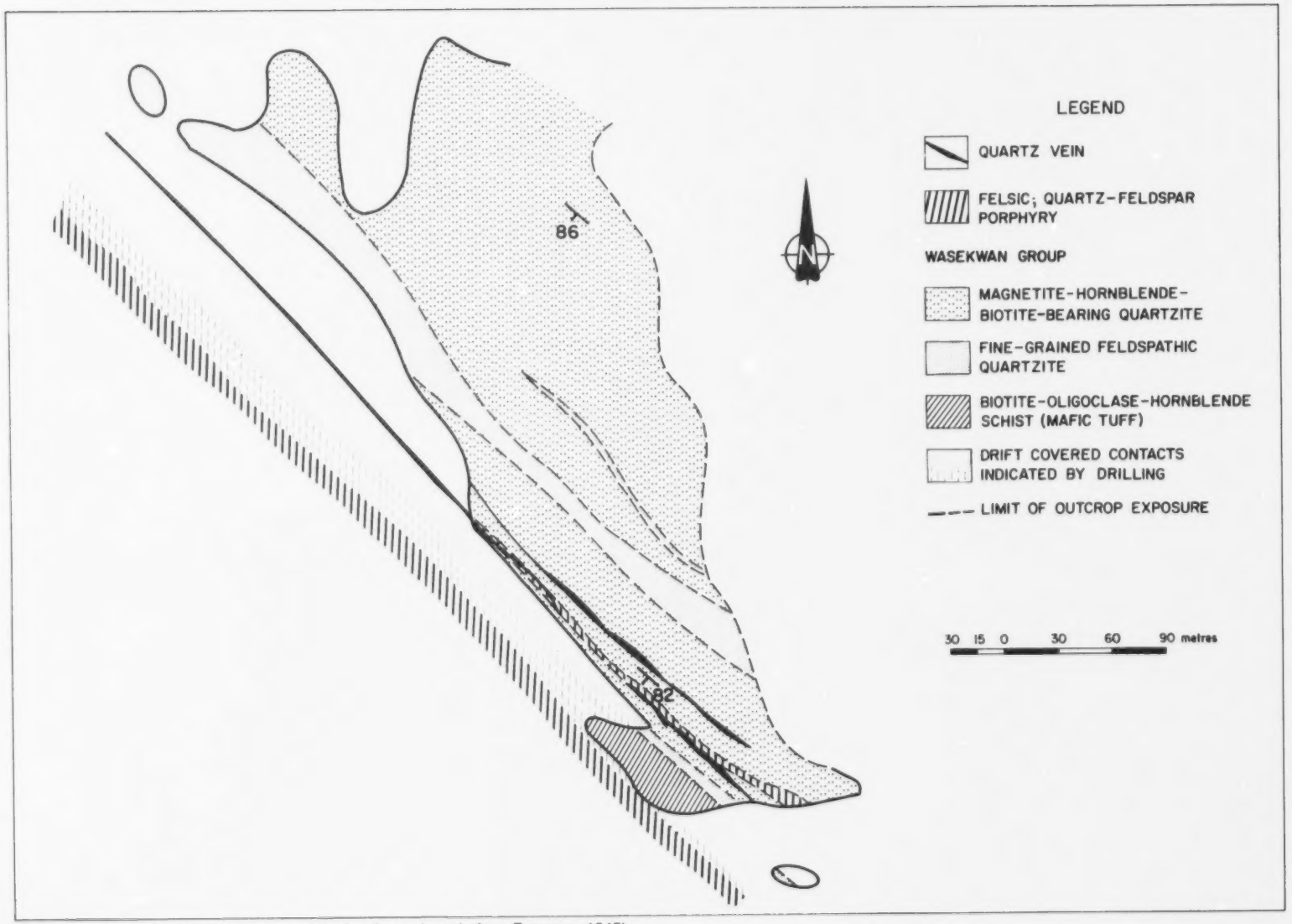


Figure 41. General geology in the area of the Lasthope deposit (from Bateman, 1945).

Exploration has outlined three zones of gold mineralization, the Wendy Zone and the South and East zones. The Wendy Zone and East Zone have combined geological reserves of 635 000 tonnes averaging 6.86 g/tonne (0.20 oz/tonne) gold (Northern Miner, January 19, 1987, p. 13). The South Zone contains an estimated 363 000 tonnes grading 4.80 g/tonne (0.14 oz/ton) gold.

MMR and HBED consider the deposits to be epigenetic and similar in genesis to iron formation-hosted gold deposits at Water Tank Hill and Nevoria, Western Australia where it has been proposed that the deposits formed by selective replacement of oxide facies banded iron formation by gold- and sulphur-bearing fluids (Phillips et al., 1984). Fyon et al. (1983) proposed a similar genesis for the Carshaw and Malga gold deposits at Timmins, Ontario and suggested that fluid ingress was along fractures and faults in the iron formation. Evidence supporting an epigenetic model for formation of the Farley Lake deposit are:

1) an abrupt change from barren oxide facies iron formation to gold- and sulphide-bearing iron formation.
2) the deposits and the surrounding alteration zone crosscut stratigraphy.
3) the concentration of gold relative to base metals in the deposit.

History of Exploration and Development:

Sherritt Gordon Mines Limited staked the area as the Lind claims in 1945. Mapping in the area discovered gold in frost heaved boulders at the west end of Farley Lake (Milligan, 1960). In 1947 drilling carried out by Sherritt on the Lind showing and in the Pot Hole Lake-Pump Lake area intersected two gold-bearing zones that assayed up to 14.0 g/tonne (0.41 oz/ton) gold (Manitoba Mines Branch, Non-confidential assessment files 91041, 91836). After this intial drilling the claims were apparently inactive until they lapsed in 1976.

HBED staked the property in 1977. From 1978 to 1983 HBED, as operator, carried out linecutting, HLEM surveys and diamond drilling in the search for base metals. MMR, as operator in a joint venture agreement with HBED, has carried out extensive exploration programs from 1983 to present. In 1986 widespread gold mineralization was discovered in three zones, two of which may be amenable to open pit mining (Manitoba Mineral Resources, News release to the Northern Miner, January 1987). In total 15 250 m of drilling was carried out. Metallurgical testing and feasibility studies are presently being conducted. In 1987 12 200 m of drilling is planned.

Selected Bibliography: Manitoba Mines Branch, Non-confidential Assessment File (91041, 91836); Milligan (1960); Manitoba Mineral Resources Ltd., News release (February 24, 1986); Stanton (1948).

Lasthope

Location: 24 km southeast of Lynn Lake.

Map Reference: Map ER86-1-4, location 3.

Description of Deposit:

The following description is summarized primarily from Bateman (1945). The area is underlain by a west-northwest-striking layered succession that from south to north comprises quartz-feldspar porphyry, mafic tuff, quartzite, mudstone, magnetite-bearing quartzite and feldspathic quartzite (Fig. 41). Two parallel quartz veins cut the quartzite. The north vein is barren, whereas the south vein contains gold-bearing sulphide mineralization. The south vein is 0.3-1.2 m wide and can be divided into two units: 1) a southern white massive quartz unit; and 2) a northern grey aphanitic, siliceous unit with disseminated grains and stringers of pyrite and trace chalcopyrite. The average sulphide content of the vein is 5% (up to 15% locally). Visible gold was not reported by either Baldwin et al. (1985) or Stockwell (1945b); however, drilling carried out by Sherritt Gordon in 1939 intersected significant gold mineralization.

History of Exploration and Development:

The area was first staked in 1937 by R. Madole. Sherritt Gordon Mines, Limited carried out a 59-hole 3129 m drill program in 1939. Drilling indicated reserves of 127 000 tonnes averaging 7.9 g/tonne (0.23 oz/ton) gold (Bateman, 1945). Lasthope Gold Mines Limited, a subsidiary of Sherritt Gordon, was incorporated to develop the property. Further drilling was carried out; however, reserves were not increased. The claims lapsed in 1977.

W.B. Dunlop Limited NPL staked the area in 1978. After the property was prospected, it was transferred first to George Leary and then to Jalna Resources Ltd.

Selected Bibliography: Baldwin et al. (1985); Bateman (1945); Gilbert et al. (1980); Manitoba Mines Branch, Mineral Inventory (64 C/10NW Au1); Milligan (1960); Stockwell (1945b)

Johnson Shear Occurrence and T1A Zone

Location: 12 km southeast of Lynn Lake, in the Foster Lake and Wasekwan Lake area.

Map Reference: Map ER 86-1-4 and Figure 35, locations 5, 14.[1]

Description of Deposit:

The Johnson Shear occurrence and T1A zone are located in the western part of the Johnson Shear Zone, 0.4 km north of Foster Lake and at the northwest corner of Wasekwan Lake, respectively. Bateman (1945) described the occurrences in this area as consisting of one or more narrow zones of shearing in "Wasekwan Series" sediments. Milligan (1960) reported that trenches and diamond drilling in the Reservoir Lake-Foster Lake area outlined several gold-bearing zones in sheared basalt flows and tuffs. Narrow quartz veins within the shear reportedly carried galena, pyrite, chalcopyrite and gold. More recently Ferreira (1986b) observed that sulphide mineralization occurs preferentially in felsic sedimentary rocks, and to a lesser extent in intermediate sedimentary rocks where fracture cleavage is well developed. Pyrrhotite, which is generally present in amounts of 1-5%, is locally present in concentrations of up to 20% and is associated with trace amounts of pyrite, rare arsenopyrite and trace chalcopyrite. The sulphide minerals occur as fine grained aggregates forming streaks along foliation planes. Deformed sulphide-bearing felsic rocks occur as siliceous lenses enveloped in intermediate rocks.

In 1985 and 1986 drilling along the T1A zone by joint venture partners SherrGold Inc. and Trans America Industries Ltd. indicated a deposit with geological reserves of 907 000 tonnes averaging 3.1 g/tonne (0.09 oz/ton) gold (Kelley, 1986).

History of Exploration and Development:

The area was first staked in 1939 by A. McVeigh and F.E. Johnston. Diamond drilling totalling more than 2100 m was carried out from 1940 to 1943. The original claims lapsed in 1966.

The area was restaked in 1973; however, work was not carried out and the claims lapsed in 1976.

P. Dunlop staked the area in 1981 and optioned it in 1985 to Sherritt Gordon Mines Limited who transferred the property to SherrGold Inc.

Selected Bibliography: Bateman (1945); Ferreira (1986b); Kelley (1986); Milligan (1960); Gilbert et al. (1980); Syme (1985).

---

[1] Map ER86-1-4 was printed before the joint venture partners published reserve figures for the T1A zone. As result it is not located on the map.

Gemmell Lake

Location: 16 km southwest of Lynn Lake

Map Reference: Map ER 86-1-4, location 5

Description of the Deposit:

The area northeast of Gemmell Lake is underlain by mafic volcanics, greywacke, and quartzite (Milligan 1960). Gilbert et al. (1980) mapped Wasekwan Group basalt flows and Sickle Group conglomerate, greywacke and staurolite schist in the area.

Mineralization consists of pyrite, arsenopyrite and minor sphalerite hosted by "cherty quartzite" (Northern Miner, May 30, 1985).

History of Exploration and Development:

The property was first staked in 1947. It received little attention until 1976 when Sherritt Gordon carried out geophysical surveys and diamond drilling northeast of Gemmell Lake (Manitoba Mines Branch, Non-confidential Assessment File, 92193). In 1985 Granges carried out diamond drilling and reported that significant mineralization was intersected in three areas: 1) hole 1 intersected 63.43 g/tonne (1.85 oz/ton) gold over a 2.41 m section; hole 2, collared 650 m to the east, intersected 5.55 g/tonne (0.16 oz/ton) gold over 2.26 m and 4.22 g/tonne (0.12 oz/ton) gold over 1.86 m; and 3) drilling on a parallel chert horizon 183 m to the north cut a low grade zone averaging 1.44 g/tonne (0.04 oz/ton) gold over a width of 9.2 m and strike length of 1000 m. Drilling continued in 1986; however, results have not been published.

Selected Bibliography: Milligan (1960); Gilbert et al. (1980); Manitoba Mines Branch, Non-confidential Assesement File (92193).

Cartwright Lake (Bonanza Claim Group)

Location: 23 km southeast of Lynn Lake, on the east side of a southern arm of Cartwright Lake.

Map Reference: Map ER96-1-4 and Figure 35, location 7.

Description of Deposit:

The property is underlain by mafic volcanic flows, phyllitic siltstone and mudstone that are intruded by felsic dykes (quartz-oligoclase porphyry). Bateman (1945) reported that a network of gold-bearing quartz veins occurs in a fractured porphyry dyke. A channel sample yielded 17.49 g/tonne ($10.60 gold at $20.67 oz/ton) over a width of 6.1 m.

More recently, assays of samples taken by Peck (1985) indicated a scattered distribution of gold within quartz-oligoclase porphyry dykes spatially associated with sulphide-rich fractures and quartz veins. Quartz occurs as 0.1-1.0 m wide fracture fillings that form an irregular network in the intrusive rocks. The quartz pods are barren of sulphides whereas the quartz networks contain up to 30% pyrite and, less commonly, arsenopyrite, galena, chalcopyrite and bornite that form massive layers at the edges of the quartz veins (Peck, 1984).

History of Exploration and Development:

The property was first staked in 1934. In 1952 nine holes were drilled by Mid-North Engineering. Based on the results of drilling carried out in 1986 SherrGold outlined a deposit with reserves that total 665 000 tonnes averaging 2.37 g/tonne (0.069 oz/ton) gold (Kelley, 1986).

Selected Bibliography: Bateman (1945); Davies et al. (1962); Gilbert et al. (1980); Manitoba Mines Branch, Corporation Files (Granville Lake Mines, Limited), Non-confidential assessment files (91290); Peck (1984, 1985, 1986).

KISSEYNEW GNEISS BELT

REGIONAL GEOLOGY

Introduction

The Kisseynew gneiss belt is a 240 km by 140 km east-trending belt of highly deformed and complexly folded Aphebian metasedimentary rocks situated in north central Manitoba and Saskatchewan near the southwest margin of the Churchill Structural Province. The gneiss belt is bounded by the Lynn Lake and Flin Flon greenstone belts to the north and south, respectively, to the east by Archean rocks of the Superior Structural Province, and by the Tabbernor Fault and granitic rocks of the Glennie Domain, Saskatchewan to the west (Fig. 42). An attenuated slice of sedimentary gneisses occurring between the LaRonge-Lynn Lake greenstone belt and the Glennie Domain in Saskatchewan may represent a western extension of the belt.

The Kisseynew belt has been divided into three main lithologic groups: 1) pelitic gneisses and migmatite derived from greywacke, siltstone and mudstone; 2) quartzofeldspathic gneisses derived from arkose, conglomerate, quartzite and feldspathic greywacke; and 3)

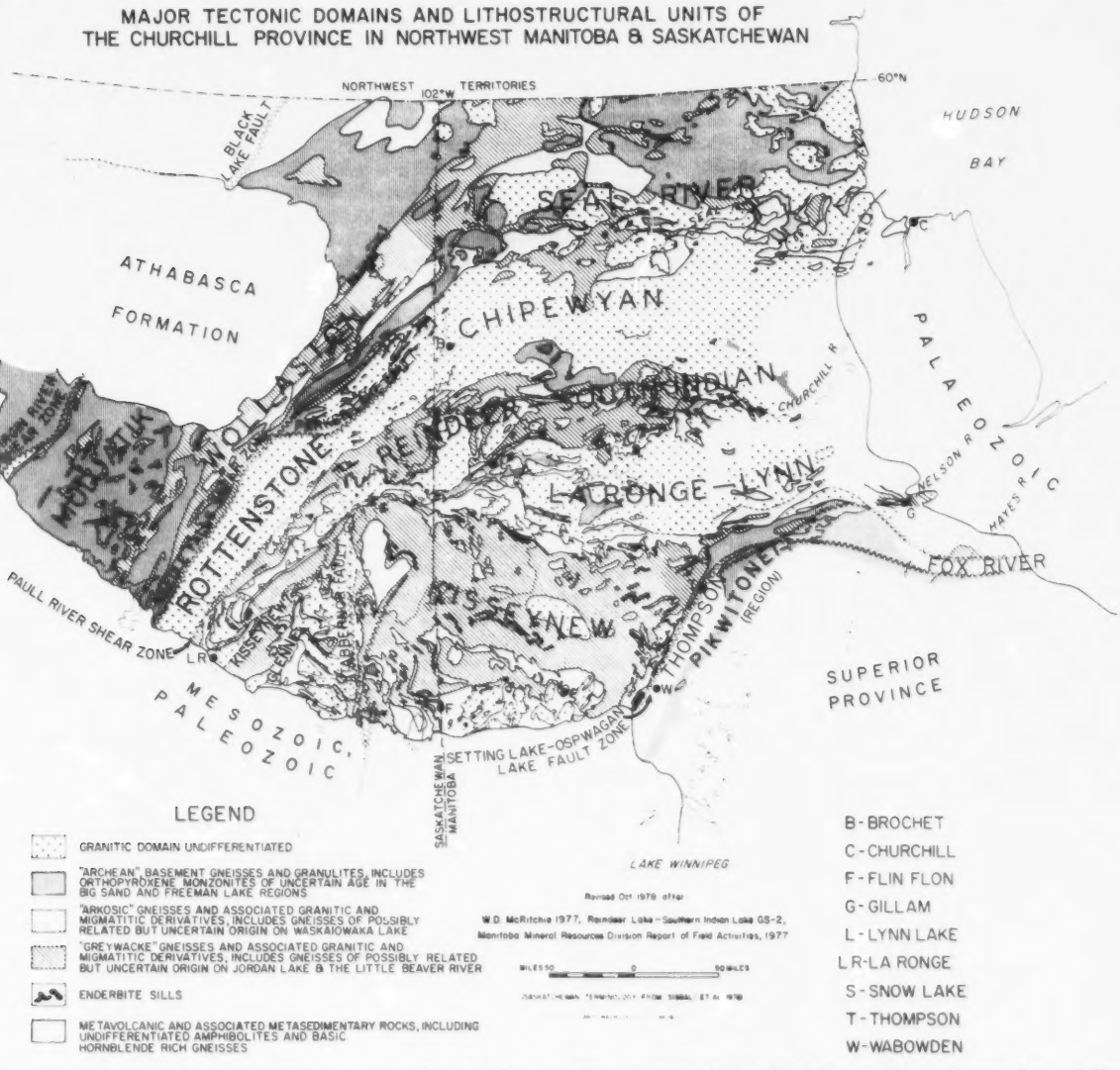

MAJOR TECTONIC DOMAINS AND LITHOSTRUCTURAL UNITS OF
THE CHURCHILL PROVINCE IN NORTHWEST MANITOBA & SASKATCHEWAN
NORTHWEST TERRITORIES
102°W
60°N
HUDSON BAY
BLACK LAKE FAULT
SEAL RIVER
ATHABASCA FORMATION
CHIPEWYAN
WOLLASTON
REINDEER
CHURCHILL R.
PALAEOZOIC
NELSON R.
HAYES R.
ROTTENSTONE
LA RONGE - LYNN
FOX RIVER
PAULL RIVER SHEAR ZONE
KISSEYNEW
THOMPSON
PIKWITONEI (REGION)
SUPERIOR PROVINCE
MESOZOIC, PALEOZOIC
SETTING LAKE-OSPWAGAN LAKE FAULT ZONE
SASKATCHEWAN
MANITOBA
LAKE WINNIPEG
LEGEND
GRANITIC DOMAIN UNDIFFERENTIATED
"ARCHEAN" BASEMENT GNEISSES AND GRANULITES, INCLUDES ORTHOPYROXENE MONZONITES OF UNCERTAIN AGE IN THE BIG SAND AND FREEMAN LAKE REGIONS
"ARKOSIC" GNEISSES AND ASSOCIATED GRANITIC AND MIGMATITIC DERIVATIVES, INCLUDES GNEISSES OF POSSIBLY RELATED BUT UNCERTAIN ORIGIN ON WASKAIOWAKA LAKE
"GREYWACKE" GNEISSES AND ASSOCIATED GRANITIC AND MIGMATITIC DERIVATIVES, INCLUDES GNEISSES OF POSSIBLY RELATED BUT UNCERTAIN ORIGIN ON JORDAN LAKE & THE LITTLE BEAVER RIVER
ENDERBITE SILLS
METAVOLCANIC AND ASSOCIATED METASEDIMENTARY ROCKS, INCLUDING UNDIFFERENTIATED AMPHIBOLITES AND BASIC HORNBLENDE RICH GNEISSES
Revised Oct 1978 after
W.D. McRitchie 1977, Reindeer Lake - Southern Indian Lake GS-2, Manitoba Mineral Resources Division Report of Field Activities, 1977
B - BROCHET
C - CHURCHILL
F - FLIN FLON
G - GILLAM
L - LYNN LAKE
LR - LA RONGE
S - SNOW LAKE
T - THOMPSON
W - WABOWDEN

Figure 42. Major tectonic domains and lithostructural units of the Churchill Province in northwest Manitoba and Saskatchewan (from McRitchie, 1977).

various intrusive rocks, the majority considered anatectic. Relatively thin discontinuous amphibolite layers and lenses commonly occur within the upper portions of the pelitic gneisses and at the pelitic/quartzofeldspathic gneiss contact in the northern portions of the belt, and at the pelitic/quartzofeldspathic contact and within the quartzofeldspathic gneisses on the southern flank.

The majority of Kisseynew rocks have been metamorphosed to middle and upper amphibolite facies with the highest grades of metamorphism and greatest migmatite development in the central portion of the belt.

Bruce (1918) defined the Kisseynew metasedimentary gneisses after their type exposures at Kisseynew Lake, Manitoba. On the southern flank of the belt the gneisses have been divided into quartzofeldspathic gneisses of the Sherridon Group (Bateman and Harrison, 1946) and older greywacke- and shale-derived gneisses and migmatites of the Nokomis Group (Robertson, 1953). Gilbert et al. (1980) have defined the arkosic gneisses and underlying greywacke-shale gneisses and migmatites as the Sickle Metamorphic Suite and Burntwood Metamorphic Suite, respectively (modified after McRitchie, 1974), in the central and northern portions of the belt (Map ER86-1-4). The distribution of major rock types and regional metamorphic zones within the Kisseynew belt exhibit a north-south bilateral symmetry from its central greywacke-derived migmatite complex outwards to flanking belts of arkose-derived gneiss and lowest metamorphic grades at its margins (McRitchie et al., 1979).

Relationships between the greywacke and quartzofeldspathic rocks and those of the bounding greenstone belts have been controversial and the subject of much debate (Harrison, 1951b; Robertson, 1951; McRitchie, 1974; Ashton et al., 1986). Early investigators (Bateman and Harrison, 1945, 1946; Harrison, 1949, 1951b; Kalliokoski, 1953) considered the Kisseynew gneisses to be in structural discordance and possibly geochronologically different from the volcanic and sedimentary rocks of the Flin Flon greenstone belt. Others (Robertson, 1951, 1953; Byers and Dahlstrom, 1954) proposed that volcanic and sedimentary rocks of the Flin Flon greenstone belt grade northward into the Kisseynew terrain. More recent geological mapping and/or metamorphic studies by Bailes (1980), Froese and Moore (1980), Gordon et al. (1985) and Ashton and Wheatley (1986) suggest the Nokomis Group sedimentary gneisses are laterally equivalent to the Amisk Group volcanic and derived sedimentary rocks, and that the Sherridon quartzofeldspathic gneisses are laterally equivalent to the Missi Group psammitic rocks. Similarly on the north flank of the gneiss belt Zwanzig et al. (1980) and Jackson and Gordon (1985) have mapped transitional lithofacies relationships between the Wasekwan Group volcanic and sedimentary rocks of the Lynn Lake belt and gneisses of the Kisseynew terrain as originally suggested by Milligan (1960).

Total rock Rb-Sr age determinations (Clark et al., 1974; Clark, 1981) and more recent U-Pb zircon ages (Gordon et al., 1987) favour an Aphebian age for the Kisseynew gneiss belt.

Nokomis Group/Burntwood Metamorphic Suite

Gneiss, migmatite and anatectic granitic bodies derived from greywacke, siltstone and mudstone predominate in the Nokomis Group/Burntwood Metamorphic Suite. Although Nokomis Group/Burntwood Metamorphic Suite rocks comprise approximately 70% of the Kisseynew belt (Bailes and McRitchie, 1978) the base has not been identified and correlation over large areas is hampered by polyphase deformation and high grades of metamorphism accompanied by anatexis. The most common rock type is a grey, massive to well layered quartz-feldspar-biotite-garnet graphite sillimanite gneiss with variable amounts of anatectic material. The metapelites are biotite-rich and may contain porphyroblasts of garnet, staurolite, sillimanite and/or cordierite. Psammitic/pelitic compositional layering on the order of mm to m and thin calc-silicate intercalations or concretions are locally prominent, particularly in the central and northern parts of the belt. Amphibolitic rocks are rare within the Nokomis Group/Burntwood Metamorphic Suite but thin, discontinuous layers and lenses have been identified near the top of this sequence on the north flank of the belt (Schledewitz, 1972; Baldwin et al., 1979; Lenton, 1981; Zwanzig, 1981) and less commonly on the south flank.

The contact between the Nokomis Group/Burntwood Metamorphic Suite and Sherridon Group/Sickle Metamorphic Suite is marked by intermittent conformable amphibolite units. Precursors to the amphibolites are considered to be: 1) volcanic rocks (Harrison, 1951b; Campbell, 1972; Gilbert et al., 1980; Lenton, 1981; Zwanzig, 1981); 2) mafic and lime-rich sedimentary rocks (Harrison, 1951; Robertson, 1953; McRitchie et al., 1979; Froese and Goetz, 1981; Zwanzig, 1984); and/or sill-like mafic intrusions (Moore and Froese, 1972; Bailes, 1975; Lenton, 1981). In general this amphibolite unit is a composite sequence that comprises massive to layered, fine- to medium-grained amphibolite locally enriched in garnet and lime that may include various quartz-rich gneisses. Marble layers, chemical sedimentary rocks and sulphidic zones are locally important constituents (Robertson, 1953; Froese and Goetz, 1981; Lenton, 1981; Gale and Ostry, 1984). Stratiform ultramafic bodies interpreted as extrusive by Zwanzig (1981) have been identified at one locality on the north flank. Although somewhat intermittent and relatively thin, detailed stratigraphic continuity and locally thick sequences of amphibolites have been identified. Pollock (1964) has correlated amphibolite rocks over 25 km that are up to 600 m thick on the south flank. More recently Zwanzig (1984) has traced an amphibolitic rock sequence along strike for at least 8 km. Gale and Ostry (1984) have identified a similar lithologic sequence that outcrops approximately 8 km east of the amphibolitic rocks described by Zwanzig (1984). Lateral stratigraphic continuity within restricted areas on the north flank of the gneiss belt has led some investigators to refer to this zone as the 'marker amphibolite' (Elphick, 1972; Schledewitz, 1972) or the 'amphibolite sequence' (Baldwin, 1974).

Sherridon Group/Sickle Metamorphic Suite

The Sherridon Group/Sickle Metamorphic Suite succession includes quartz-rich arenaceous gneiss, pelitic gneiss and calc-silicate layers with intercalated amphibolite. Arkose-derived rocks that commonly contain accessory magnetite predominate; however, compositions of the psammitic rocks range from impure arkose to greywacke and quartzite. Polymictic metaconglomerate commonly occurs at or near the base of the Sherridon Group/Sickle Metamorphic Suite in an apparently conformable position and in sharp contact with the underlying amphibolite and/or Nokomis Group/Burntwood Metamorphic Suite rocks. Transitional relationships in the basal parts of this succession from amphibolite to arkosic gneiss have been observed locally (Baldwin, 1974; Lenton, 1981) in the northern portion of the belt. Baldwin et al. (1979), Zwanzig (1981) and Lenton (1981) have developed regional stratigraphic correlations within the Sickle suite in the central and northern parts of the Kisseynew Belt. Intense deformation and the highly variable nature of the stratigraphy within areas mapped as Sherridon Group has precluded correlations of this nature on the south flank. Robertson (1953), Kornick (1968) and Froese and Goetz (1981) have identified a stratiform anthophyllite-rich rock unit within quartz-rich Sherridon gneiss that, if correlatable, would provide some regional stratigraphic control. Gale (1980) and Ostry (1986) have identified a similar rock associated with quartz-rich gneiss elsewhere on the south flank. This rock contains biotite and commonly garnet and cordierite with local concentrations of sulphides. Froese (1985) has interpreted this unit as derived from sedimentary material that underwent in situ chloritization prior to high grade metamorphism.

Intrusive Rocks

The Kisseynew belt includes intrusive rocks of various ages and compositions considered by most investigators to be post-Sherridon Group/Sickle Metamorphic Suite deposition (Bailes, 1975, 1980; Lenton, 1981). Intrusive rocks comprise: 1) enderbite sills; 2) granitoid plutons; 3) gneissic domes; and 4) crosscutting dykes. The earliest intrusions are considered to be large sill-like bodies of enderbite (McRitchie et al., 1979) that are restricted to the southwest-central portion of the belt (Fig. 42) and probably associated with the first major deformation (McRitchie et al., 1972). Tonalite, granodiorite and quartz monzonite batholiths and smaller irregular plutons occupy the core of the belt and are flanked by northwest-trending granitic dyke complexes (Baldwin et al., 1979). All are considered to be derived from anatexis of the greywacke gneiss during a high temperature metamorphic event. Transitional margin relationships between the intrusions and enveloping sedimentary gneisses are common (Bailes, 1975; Lenton, 1981). Large domal intrusions and intrusive complexes commonly exhibiting gneissic textures and layering are distributed along the north and south flanks of the belt. Bailes (1975) mapped eight domes near the southeast limit of the belt and has interpreted these as derivations of mobilized Sherridon Group quartzofeldspathic gneisses generated during a high grade metamorphic event. A series of ellipsoidal granitoid domes flanked by quartzofeldspathic Sherridon-type gneisses near the southwestern margin are interpreted to represent highly compressed megaboudins of an early pre-deformation granitic intrusion (McRitchie, 1986). Farther to the east along the south flank Zwanzig (1984) has documented numerous gneissic tonalitic domes that he considers to predate deposition of the Sherridon Group. Domal complexes along the Lynn Lake-Kisseynew belt margin are interpreted to have been generated by remobilization of early plutonic suites during early recumbent folding and nappe development (Map ER86-1-4). Most units are transected by numerous late narrow granitic dykes that are themselves cut by northerly trending pegmatitic dykes (McRitchie et al., 1979).

METAMORPHISM

Grade of metamorphism increases from the margins toward the centre of the Kisseynew belt and ranges from middle to uppermost amphibolite facies. On the basis of observed changes in metamorphic mineral assemblages of pelitic and semi-pelitic rocks within the belt Bailes and McRitchie (1978) have developed a four-fold regional metamorphic zonation: 1) low grade mineral assemblages characterized by chlorite and biotite that are confined to the margins with the adjacent greenstone belts; 2) medium grade, characterized by moderate recrystallization, minor anatexis and porphyroblastic growth of garnet and staurolite; 3) high grade A, characterized by more intense recrystallization, sillimanite-garnet mineral assemblages and migmatite development; and 4) high grade B, distinguished by coarse recrystallization, extensive migmatite development and the stable assemblage garnet-cordierite-K-feldspar. The transition from relatively low grade to high grade metamorphism generally occurs within 10-30 km of the belt margins (Bailes and McRitchie, 1978; Jackson and Gordon, 1985). Reactions in pelitic rocks similar to those discussed by Bailes and McRitchie have been documented by various investigators in the south part of the Kisseynew belt (Harrison, 1949; Froese and Gasparrini, 1975; Froese and Moore, 1980; Bailes, 1975, 1980; Gordon, 1981; Gordon et al., 1985) and on the north flank (Zwanzig et al., 1980; Jackson and Gordon, 1985).

STRUCTURE

Up to four sets of folds and two episodes of brittle deformation have been recognized throughout the Kisseynew gneiss belt. All deformation is considered to postdate deposition of the Sherridon Group/Sickle Metamorphic Suite (Bailes, 1980; Lenton, 1981).

The earliest deformation (D1), common to all areas of the belt, is considered to have produced large-scale recumbent isoclinal folds (F1) or nappe-like structures that verge to the north and south on the north and south flanks of the Kisseynew belt respectively. Most investigators have inferred this style of folding from regional inversions and repetitions of stratigraphy that have been deformed by later recognizable folds (Pollock, 1965; Pearson, 1972; Elphick, 1972; Schledewitz, 1972; Bailes, 1975; Baldwin et al., 1979; Tuckwell, 1979; Zwanzig, 1984). Bailes (1980) provides substantive evidence for the recumbent nature of F1 folding on the south flank of the Kisseynew belt. There, a strongly differentiated sill-like gabbro body is interpreted to have intruded axial planar to the F1 folds. Lenton (1981) has identified and mapped an F1 fold closure and axial surface near the north flank of the belt. F1 fold axes are thought to parallel the easterly regional trend of the belt. Transposition of bedding and development of the main regional schistosity/gneissosity defined by biotite and/or hornblende alignment parallel to compositional layering were effected during the D1 event.

Major north-northeast- and east-trending folds (F2) in the central and southern portions of the belt (Pearson, 1972; Bailes, 1975; Baldwin et al., 1979) and northwest-trending folds (Lenton, 1981) and east-trending folds (Elphick, 1972; Schledewitz, 1972) on the north flank were generated during the second major deformational event (D2). Zwanzig (1984) has suggested that east-trending F2 folds with axial planes overturned to the south may be associated with major shear zones that occur along the Flin Flon-Kisseynew belt contact. Refolding of the early recumbent folds has produced dome and basin interference patterns, prevalent throughout the Kisseynew gneiss belt. Local development of axial planar schistosities and cataclastic foliations accompanied D2 deformation. Both F1 and F2 folds are believed to have resulted from north-south compressive stresses generated during periods of crustal shortening.

The youngest folds (F3 and/or F4) are of the open and flexural type with axial surfaces that strike northeasterly (Elphick, 1972; Schledewitz, 1972; Bailes, 1975; Baldwin et al., 1979; Zwanzig, 1984) and are associated with development of strong linear fabrics. The final phases of deformation (D4 and D5) produced faults, cataclastic zones and fractures commonly in the NE, N and NW directions.

MINERALIZATION

Although the Kisseynew belt is recognized for the Cu-Zn massive sulphide mineralization at Sherridon, Manitoba and several smaller massive sulphide deposits in the vicinity, scattered gold occurrences have been known since the 1950s. Gold prospects were noted by Robertson (1953) and Pollock (1964, 1965) on the south flank, in the central region by Quinn (1955) and on the north flank of the belt by Hunter (1953), Milligan (1960) and Barry (1965).

The Kisseynew belt, situated between the Lynn Lake and Flin Flon-Snow Lake mining camps, has traditionally received little attention from mineral explorationists. Recent developments such as the increased availability of exploration funds, presence of significant gold at Nokomis Lake and Evans Lake (reviewed by Gale and Ostry, 1984 and Peloquin et al., 1985) and the decision to put the Puffy Lake gold deposit into production (Northern Miner, January 28, 1987) have renewed interest in the gold potential of the Kisseynew belt. In response to these factors and coupled with an insufficient understanding of the stratigraphy and nature of the gold mineralization along the south flank of the belt the Manitoba Government initiated a regional mapping program (Zwanzig, 1983, 1984, 1985; McRitchie, 1985, 1986; Schledewitz, 1985; Schledewitz and Trembath, 1986) and mineral deposit studies (Gale and Ostry, 1984; Peloquin et al., 1985; Ostry, 1986) in this area. Geological mapping of the central and northern portions of the belt by Manitoba Government geologists were completed circa 1980.

Reports of gold mineralization in the central and northern portions of the belt are rare. On the north flank Hunter (1953) reported minor gold in pyrite-quartz stringers associated with intrusive rocks. Milligan documented a quartz vein hosted Au-Cu prospect within amphibolitic rocks near the Lynn Lake-Kisseynew contact, and gold and disseminated arsenopyrite mineralization associated with amphibolites and metasedimentary rocks was reported by Barry (1965). The amphibolites at the latter occurrence include volcanic flow rocks and occupy a stratigraphic position near the top of the Burntwood Metamorphic Suite (Zwanzig, 1980). Disseminated pyrrhotite with local concentrations of chalcopyrite, galena, silver and gold at several scattered localities in the central portion of the belt were reported by Quinn (1955).

On the basis of a regional compilation of non-confidential geological and geophysical assessment data, available geological maps, and the locations of documented mineral occurrences along the south flank of the belt, Gale and Ostry (1984) postulated that known gold mineralization occupies a stratigraphic position that approximates that of the known massive sulphide occurrences. This stratigraphic sequence is characterized by a thin variable unit of volcanogenic and sedimentary rocks, predominantly amphibolite, that occurs between greywacke-derived gneiss of the Nokomis Group and Sherridon Group quartzofeldspathic gneiss. Previous investigators in Manitoba have drawn attention to local Fe sulphide mineralization variably accompanied by minor chalcopyrite (Robertson, 1953; Pollock, 1965; Barry, 1965; McRitchie et al., 1972;

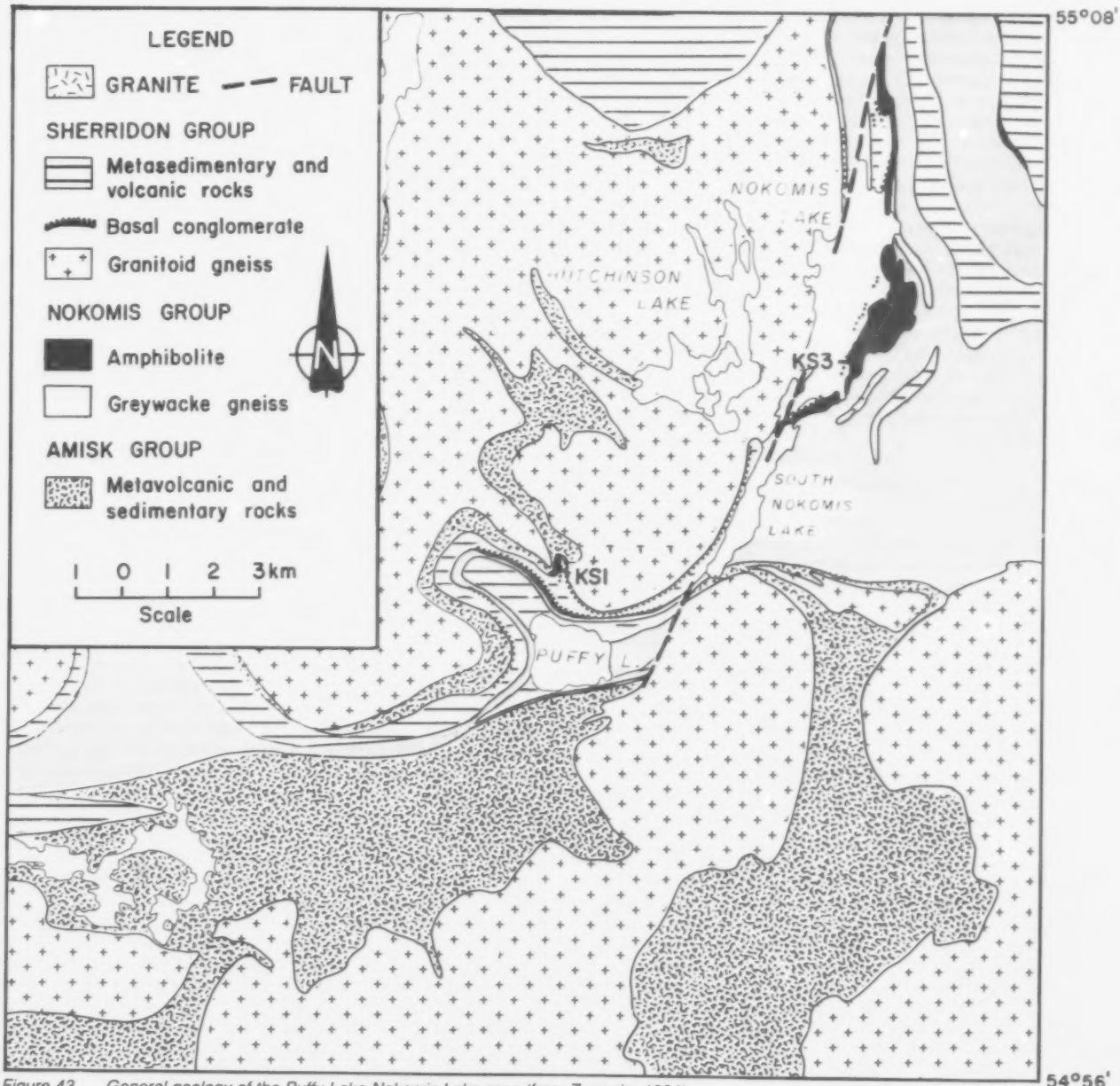


Figure 43. General geology of the Puffy Lake-Nokomis Lake area (from Zwanzig, 1984).

Elphick, 1972; Schledewitz, 1972) and rare arsenopyrite (Lenton, 1981) associated with amphibolitic rocks at this stratigraphic interval.

Detailed investigations at the Nokomis Lake deposit and the Evans Lake occurrence (Map ER86-1-3, locations KS3, 6) indicated stratabound gold-bearing arsenopyrite mineralization within a distinctive conformable amphibolitic rock sequence that occurs between greywacke and arkose-derived gneisses (Gale and Ostry, 1984 and Peloquin et al., 1985). At both localities (Map ER86-1-3, locations KS3, 6) local gold and sulphide mineralization is restricted to a mottled 'quartz-rich gneissic rock' containing variable quartz, plagioclase, hornblende, garnet and magnetite that forms a layer up to 20 m thick within the amphibolitic rocks. Visual evidence for hydrothermal alteration associated with the mineralization was not recognized. Apparent similarities between the geologic setting of gold mineralization at Squall Lake and that at Nokomis and Evans Lake were noted by Gale and Ostry (1984). The Squall Lake gold deposit (Harrison, 1949) and scattered gold-quartz vein deposits that include the Cyclone and Moss 1 (Map ER86-1-3, locations KS4, 5) deposits occur in the Snow Lake area at or near the southern limit of the Kisseynew belt. At Squall Lake the host rock unit, described by Harrison as a biotite diorite sill, also contains well layered mafic volcanogenic rocks and occupies a conformable position between arkose-derived rocks and typical Nokomis-type greywacke-derived gneisses (Gale and Ostry, 1984). The Cyclone and Moss 1 deposits and at least one small Cu-rich massive sulphide deposit (described by Bailes, 1975) are hosted by hornblende-plagioclase gneisses and amphibolite that occur adjacent to a meta-arkose/meta-subgreywacke unit and encircle the gneissic domes in the area. Bailes (1975) has interpreted the meta-psammites and domal rocks as derived from Missi/Sherridon sedimentary strata.

Observations at the Puffy Lake gold deposit (Ostry, 1986) indicate a different host lithology and style of mineralization from that documented elsewhere on the south flank. The mineralized zone at Puffy Lake comprises gold-bearing arsenopyrite mineralization within undeformed quartz veins that are apparently conformable with the regional structural trend and occur within biotite-rich pelitic gneiss, possibly of the Nokomis Group. The gneissic succession at the deposit differs from that observed elsewhere on the south flank in that a layered sequence of volcanic and/or reworked volcanic-derived gneiss apparently constitutes an important part of the stratigraphy in the Puffy Lake area.

Elsewhere on the south flank, trace gold associated with disseminated pyrite and/or fuchsite within sheared or faulted rocks near the top of a greywacke-derived gneissic unit in the Kipahigan Lake area was reported by Pollock (1964, 1965).

Within the Saskatchewan extension of the gneiss belt Parslow and Gaskarth (1985) and Parslow (1986) studied amphibolitic rocks occurring between greywacke and arkosic units and determined that geochemically anomalous concentrations of gold variably occur within the amphibolites.

In the Nokomis and Evans Lake areas Ostry (1986) has suggested that the Kisseynew gneisses consist of a quartz-rich quartzofeldspathic gneiss (originally mapped as Sherridon by Robertson (1953)) that is dissimilar to the arkosic gneisses in the repetitive sequence of greywacke and arkose-derived gneisses (originally mapped as Nokomis by Robertson (1953)). In addition, compositionally different amphibolite units locally occur at major lithologic contacts and commonly within the arkosic units. This interpretation, if substantiated, would provide a better understanding of the stratigraphy on the south flank of the Kisseynew belt and the basis to identify particular lithologic units of higher potential to contain gold.

GOLD DEPOSITS

Puffy Lake

Location: 61 km northeast of Flin Flon, 1 km north of Puffy Lake.

Map Reference: Map ER86-1-3, location KS1.

Description of Deposit:

The Puffy Lake area is underlain by Amisk Group and Nokomis Group rocks that are intruded by granite domes *(Fig. 43)*. Overlying these rocks disconformably is the Sherridon Group.

Two phases of folding deform rocks in the area: 1) early high amplitude folds; for example, a narrow 50 m thick "layer" of metagreywake occupies the core of an early isoclinal anticline; and 2) late

Figure 44. Aerial view of Pioneer Metals Corporation's Puffy Lake property, Puffy Lake, Manitoba (August 1986).

northwest-trending cross folds, such as the fold that trends northwest from Puffy Lake (Zwanzig, 1984).

The gold mineralization occurs in a quartz vein(s) more than 1 m thick, conformable to the regional structural trend in the area and occurring near the structural base of a fine grained biotite-rich gneiss garnet with hornblende layers (Ostry, 1986). Mineralization consists predominantly of pyrite, pyrrhotite and arsenopyrite with lesser amounts of galena, sphalerite and chalcopyrite. The sulphides form zones within undeformed white to smoky grey quartz veins of up to 15%; visible gold is present locally. Wall rocks are fine grained biotite-rich quartz-feldspar schists that commonly contain up to 20% arsenopyrite.

History of Exploration:

In the early 1960s Hudson Bay Mining and Smelting Co., Limited carried out geophysical surveys on the north shore of Puffy Lake. Follow up drilling intersected several mineralized zones that when assayed yielded low grade gold values (Manitoba Mines Branch, Non-confidential Assessment File, 91872).

In 1980, Maverick Mountain Resources Limited optioned the property from Granges Exploraton Aktiebolag. In early 1981 Maverick completed a 30-hole drill program and estimated reserves of 428 000 tonnes averaging 7.68 g/tonne (0.224 oz/ton) gold (Canadian Mines Handbook 1982-83). During the winter of 1984-85 a 28-hole 1104 m drill program extended the known strike length of mineralization to 1037 m. A second zone, 275 m north of the main zone, was also discovered. Drill indicated reserves at the completion of the program were calculated to be 603 000 tonnes averaging 6.86 g/tonne (0.20 oz/ton) gold (Northern Miner, May 23, 1985). A $2 million underground development program was carried out from June to August 1986.

In October 1986 Maverick Mountain Resources Limited and Pioneer Metals Corporation merged, under the latter's name. Following the completion of a feasibility study the company decided to put the deposit into production (Pioneer Metals Corporation, News release, January 19, 1987). The deposit is estimated to contain probable and possible reserves of 1 220 000 tonnes averaging 7.89 g/tonne (0.23 oz/ton) using an average mining width of 2 m, a cutoff grade of 3.4 g/tonne (0.1 oz/ton) and a 10% dilution factor.

Selected Bibliography: Manitoba Mines Branch, Corporation File (Granges Exploration Aktiebolag, Maverick Mountain Resources Limited); Ostry (1986); Zwanzig (1984)

Squall Lake

Location: 6.5 km northwest of Snow Lake, between Squall Lake and McLeod Lake.

Map Reference: Map ER86-1-3, location KS2.

Description of Deposit:

The following description is summarized primarily from Harrison (1949). The Squall Lake deposit and several gold occurrences are located on the northwest limb of a northeast-trending synform. The area is underlain by garnet-staurolite schist and arkosic gneisses that are intruded by a biotitic diorite sill. Gold mineralization occurs in three discontinuous subparallel lenses over a stratigraphic thickness of 60 m at or near the hangingwall contact of the diorite sill: 1) the uppermost zone is within arkose and consists of a quartz and quartz-carbonate stockwork; 2) the middle or main zone occurs at the upper contact of the diorite with arkose and consists of a series of lenses within silicified and slightly carbonatized diorite; and 3) a lower zone that is up to 2 m wide occurs within silicified and carbonatized diorite. Arsenopyrite is the main sulphide and where quartz and chlorite are also present gold is associated with it.

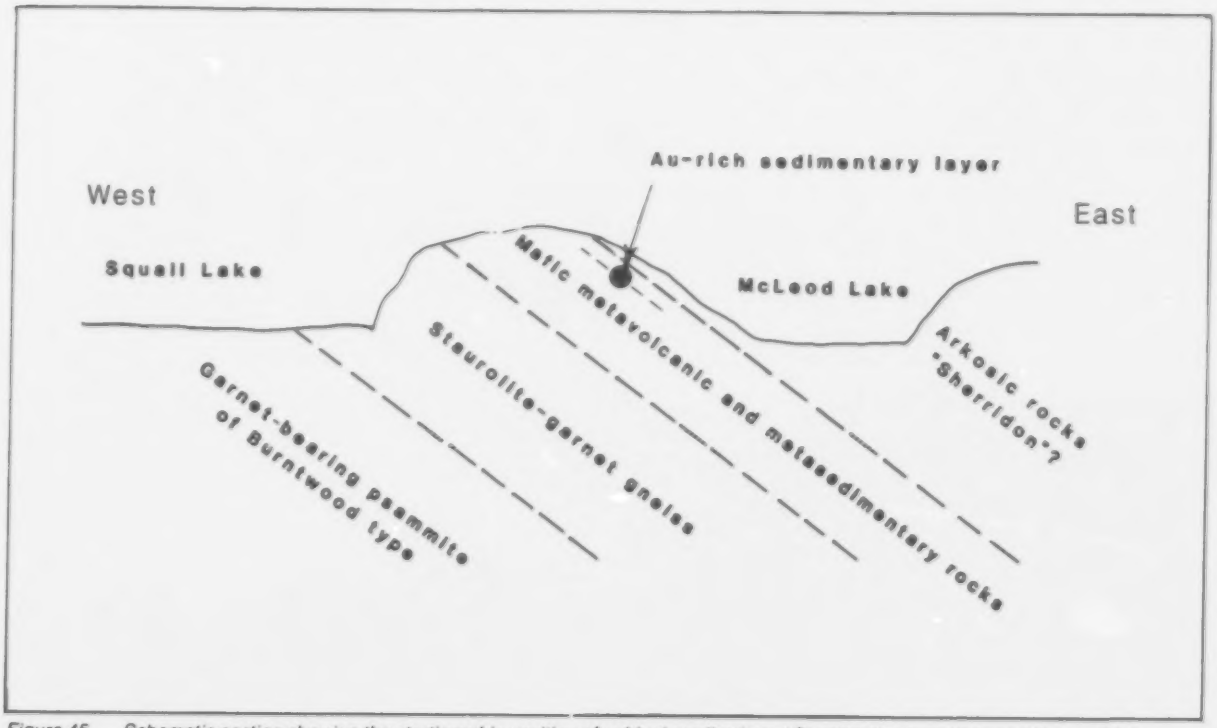


Figure 45. Schematic section showing the stratigraphic position of gold mineralization at Squall Lake (from Gale and Ostry, 1984).

Gale and Ostry (1984) reinterpreted the diorite sill as a well layered sequence of mafic metasedimentary or metavolcanic rocks (Fig. 45) and tentatively assigned them to the Kisseynew metallotect.

History of Exploration and Development:

The area was first staked in 1924. Numerous individuals held claims in the area between Squall and Moore Lake from 1924 to 1945; however, limited exploration work was undertaken. During 1944-45 Wekusko Consolidated Limited staked and optioned approximately 103 claims in the area. They carried out an 8309 m drill program that intersected significant mineralization. Samples returned assays ranging from 3.09 g/tonne (0.09 oz/ton) to 14.4 g/tonne (0.42 oz/ton) gold over widths of 0.76 m to 2.75 m. Squall Lake Gold Mines Limited acquired the property in 1945 and carried out 7642 m of drilling to test mineralized zones at greater depth. A series of 17 holes intersected mineralization averaging 9.09 g/tonne (0.27 oz/ton) gold over 1.49 m. The property remained dormant until the claims were cancelled in 1977.

In 1977 and 1978 Stan Major and Hudson Bay Exploration and Development staked claims over the area. Hudson Bay carried out linecutting, geophysical surveys and diamond drilling before the claims lapsed in 1981. In 1980, within a period of 3 months, the Stan Major property was transferred to Corporate Oil and Gas Limited, W. Bruce Dunlop Limited (NPL) and finally to Camflo Mines Limited (in 1984 Camflo Mines amalgamated with Barrick Resources Corporation under the latter's name). Geophysical surveys were carried out in 1981 and were followed by mapping and diamond drilling that indicated reserves of 1 088 621 tonnes averaging 6.85 g/tonne (0.20 oz/ton) gold (Northern Miner, October 18, 1984). A further 5000 m of drilling was completed that outlined 680 000 tonnes grading 3.43 g/tonne (0.1 oz/ton) gold (Northern Miner, January 10, 1985). In 1987 Zenco Resources Inc. acquired 100% interest in the property.

References: Gale and Ostry (1984); Harrison (1949); Manitoba Mines Branch, Corporation File (Squall Lake Gold Mines Limited), Mineral Inventory File (63 K/16 Au10).

Nokomis

Location: 55 km northeast of Snow Lake, on the east shore of Nokomis Lake.

Map Reference: Map ER86-1-3, location KS3.

Description of Deposit:

The area immediately east of Nokomis Lake is underlain by Nokomis Group amphibolite. The deposit is located within the amphibolite in a 20 m thick quartz-rich gneissic rock containing quartz, hornblende, plagioclase and garnet (Gale and Ostry, 1984). Pyrite and pyrrhotite are the most common sulphide minerals and occur mainly as disseminations throughout the quartz-rich gneiss in a layer 1-2 m thick; arsenopyrite occurs locally. Gold appears to be associated with the arsenopyrite. Peloquin et al. (1985) stated that the gold-bearing mineralized zones are essentially stratabound within the quartz-rich gneiss with sulphide veinlets tending to occur toward the structural base of the quartz-rich gneiss.

Rio Tinto Canadian Exploration Limited reported the "vein zone" outlined by their 1961 drilling program was 152 m long and 3.32 m wide (Mines Branch, Non-confidential Assessment File, 90657-59).

History of Exploration and Development:

The property was first staked in 1952 by S.C. Simpson. A.L. Parres optioned the property in 1958 and carried out a 5-hole drill program. The option was dropped in 1960. In 1961 Rio Tinto Canadian Exploration Limited optioned the property and carried out a 41-hole 2860 m drill program that outlined possible reserves of 90 700 tonnes grading 10.29 g/tonne (0.3 oz/ton) gold. The claims lapsed in 1971.

Dome Exploration (Canada) Limited staked the property in 1974 and carried out geophysical surveys and diamond drilling in 1975. In 1985 additional diamond drilling was carried out.

Selected Bibliography: Bailes (1971); Davies et al. (1962); Gale and Ostry (1984); Manitoba Mines Branch, Mineral Inventory File (63 N/2 Au1), Non-confidential Assessment File (90657-59); Peloquin et al. (1985); Robertson (1953).

Cyclone (Sask-Mani)

Location: 18.5 km northeast of Snow Lake, on the west shore of the northeast arm of Herblet Lake.

Map Reference: Map ER86-1-3, location KS4.

Description of Deposit:

The property is underlain by Nokomis Group quartz-biotite and quartz-hornblende gneisses that are intruded by pegmatite and aplite dykes (Wright, 1931). The schistosity and bedding strike 005 and dip 45 E.

Quartz stringers and lenses 0.6 to 5.1 cm wide occur along cleavage and fracture planes within thin beds of hornblende gneiss interbedded with thicker more massive gneiss. A section across one of the ribs of the shaft consisted of the following units, described from footwall to hanging wall:

- 0.23 m of footwall gouge
- 0.92 m of mica gneiss with a few quartz lenses and stringers less than 0.6 cm wide.
- 0.38 m of jointed mica gneiss with lenses of quartz up to 1.27 cm in width.
- 5.1 cm wide gold-bearing quartz vein (at the hangingwall contact with quartz-mica gneiss).

History of Exploration and Development:

The property was first prospected in 1916 when J. Kerr staked the property. Cyclone Development Company sank a shaft to a depth of 15 m in 1926. A small mill was installed and a test run of 27 tonnes of ore averaged 19.89 g/tonne (0.58 oz/ton) gold (Wright, 1931). In 1929 Taylor assigned his interest in Cyclone to Broad Bay Mining Company, Limited. The assets of Broad Bay were absorbed in 1929 by a new company, the Sask-Mani Precious Metals Mining Company Limited.

Numerous individuals staked the property from 1952 to 1976; however, little work was undertaken.

In 1978 Granges Exploration Aktiebolog staked the property and carried out a 2-hole 143 m drill program. Hole AB-34 intersected minor sulphides that when assayed yielded trace amounts of gold (Manitoba Mines Branch, Non-confidential Assessment File 99849). The claims were allowed to lapse in 1982.

In 1982 P. Dunlop staked the property and carried out sampling and stripping.

Selected Bibliography: Manitoba Mines Branch, Corporation File (Sask-Mani Precious Metals Mining Company), Mining Engineering Files (Sask-Mani Precious Metals Mining Company), Mineral Inventory File (63 J/13NW Au24), Non-confidential Assessment File (99849); Wright (1931).

Moss 1

Location: 13.5 km northeast of Snow Lake, on the western shore of the northeast arm of Herblet Lake.

Map Reference: Map ER86-1-3, location KS5.

Description of Deposit:

Sheared amphibolite hosts gold-bearing quartz stringers over widths of up to 6.1 m and along a strike length of 458 m. Mineralization consists of disseminated pyrite, chalcopyrite and pyrrhotite. Tungsten mineralization occurs locally (Cole, 1942).

History of Exploration and Development:

The area was first staked in 1916 by R. Kerr. In late 1942 W. Ringsleben of the Metals Controller's Office, Ottawa took samples that averaged 0.384% WO_3 across 7.6 m (Manitoba Mines Branch, Unpublished Information File 63 J/13NW). Trenching, stripping, and blasting were done in the mid-1940s. A 5.5 m channel sample across one trench assayed 12.73 g/tonne (0.37 oz/ton) gold (Northern Miner, Jan. 1, 1946). In 1946 the property was assigned first to J.R. Starnes and then to W.H. Stainton Limited.

Ferguson Mines Limited acquired the property in 1950. Of 22 channel samples taken in the main trench, 12 averaged 6.86 g/tonne (0.20 oz/ton) gold. By May 1950, approximately 8164 tonnes of ore averaging 25.71 g/tonne (0.75 oz/ton) had been broken. A 13.6 tonne Gibson mill was installed; however, there is no record of any gold being produced.

Since the Moss 1 claim lapsed in 1973, the property has been staked by W.B. Dunlop, B. Gulka and P. Dunlop.

Selected Bibliography: Bailes (1971); Cole (1942); Manitoba Mines Branch, Annual Report on Mines and Minerals (1928, 1951), Corporation File (Ferguson Mines Limited), Mineral Inventory File (63 J/13NW, Au20), Unpublished Information File 63 J/13NW; Wright (1931)

SEAL RIVER AREA

REGIONAL GEOLOGY

The Seal River area, defined as extending from Tadoule Lake eastwards straddling Seal River and the northeast portion of North Knife River to the west shore of Hudson Bay, is situated in the Churchill Province of the Precambrian Shield *(Fig. 46)*. The area is characterized by a paucity of outcrop and where rocks do outcrop they are highly recrystallized and structurally complex. As a consequence Schledewitz (1986) classified the rocks into four broad groups *(Table 6)*:

1) Archean or probable Archean rocks.
2) Metasedimentary and localized metavolcanic rocks (Sequence I) of uncertain or mixed age;
3) Metasedimentary rocks (Great Island Group) of Aphebian age; and
4) Hudsonian igneous rocks

Sequence I sedimentary and volcanic rocks and Great Island Group sedimentary rocks are underlain by Archean granitic rocks. The sedimentary and volcanic rocks of Sequence I are intruded by granitic rocks ranging in composition from porphyritic quartz diorite to granite. The basal rocks of the Great Island Group are intruded by younger granites. A series of widely spaced occurrences of foliated granodiorite to tonalite, migmatite and amphobilite that occurs northeast of Tadoule Lake and 30 km east of Great Island has an unknown relationship to the above groups. Schledewitz (1986) was uncertain whether the granodiorite and tonalite are related to similar rocks with unknown affinities that occur outside the Seal River area or whether they are part of the Archean grantic rocks that underlie Sequence I.

Sequence I

These rocks outcrop over limited areas at Great Island and along the lower Seal River. The metavolcanic rocks at Great Island form the lower part of a structural basin 30 km wide by 50 km long. The volcanic rocks comprise massive and pillowed andesite; interlayered tuffaceous rocks and andesite; interlayered tuffaceous rocks, lapilli tuff and siliceous metasedimentary rocks; rhyolite to rhyodacite; and conglomerates (Schledewitz, 1986). The volcanic rocks along the lower Seal River comprise pillowed andesite flows, a rhyodacite lens and interlayered massive andesite, and intermediate to basic tuffs.

Great Island Group

Great Island Group rocks occur as erosional remnants in the Great Island and Meade Lake area, along the Seal River east of Great Island, along the North Knife River and in the Churchill area. The basal units are composed of oligomictic or polymictic conglomerate, protoquartzite and interlayered phyllite to biotite schist, grey green phyllite, and biotite schist. Basal units are overlain by conglomerate, siltstone, dolomitic marble, argillite, garnet-amphibole schist (iron formation), pyritic argillite, greywacke and interlayered greywacke and green phyllite, and Churchill quartzite.

METAMORPHISM

The area is characterized by regional upper greenschist to middle amphibolite facies metamorphism. Contact metamorphism is in evidence along the north and south margins of the domain.

TABLE 6
GENERAL STRATIGRAPHY OF THE SEAL RIVER AREA
(after Schledewitz, 1986)

Proterozoic	Intrusive Rocks	— Granite, quartz monzonite
Proterozoic-Aphebian	Great Island Group	— Metasiltstone and meta-argillite — Metagreywacke — Garnet amphibolite schist (iron formation) pyrrhotite magnetite and black pyritic meta-argillite black acicular amphibole garnet — Dolomitic marble quartz clinochlore — Quartzite and interlayered pale green phyllite to biotite muscovite schist garnet — Oligomictic and polymictic conglomerate — Interlayered red and or green metagreywacke and grey phyllite — Black meta-argillite with quartz pebbles — Metaconglomerate with: muscovite-biotite-quartz siltstone matrix with quartzite clasts, interlayered grey siltstone with pebble beds
	Intrusive Rocks	— Quartz-feldspar porphyry, gabbro
Proterozoic and/or Archean	Sequence I	— Conglomerate — Conglomerate and greywacke — Metasiltstone — Amphibolite — Andesite and minor basalt — Interlayered tuff and pillowed basalt — Interlayered tuff and pillowed andesite — Intermediate tuff, lapilli tuff and interlayered siliceous metasedimentary rocks, local rhyodacite and andesite flows — Rhyolite to rhyodacite
Archean or Proterozoic?		— Foliated granodiorite to tonalite amphibolite

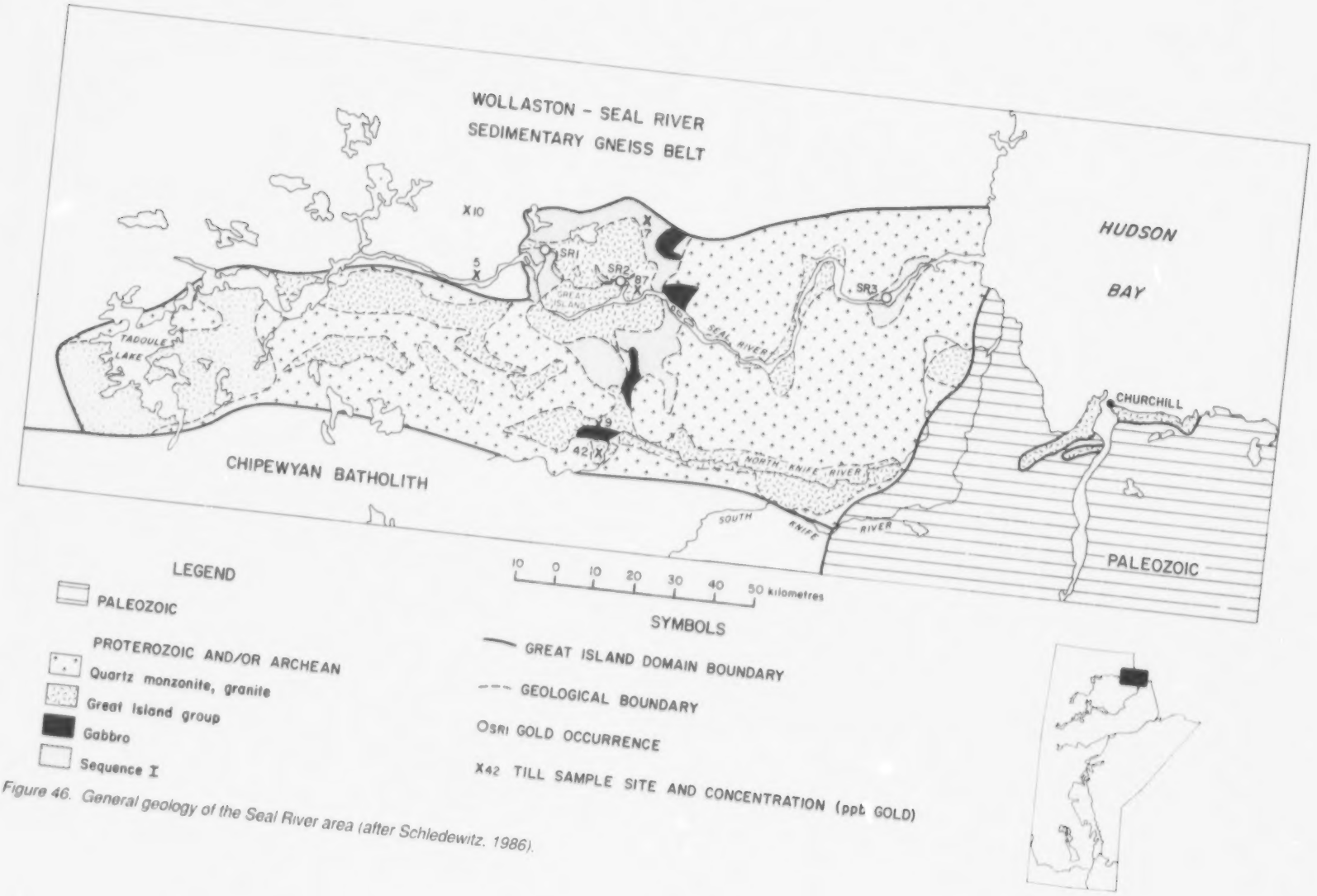


Figure 46. General geology of the Seal River area (after Schledewitz, 1986).

STRUCTURE

Schledewitz (1986) grouped the structure of the Great Island Domain into three areas: 1) Tadoule-Wither Lake folds; 2) Great Island basin structure; and 3) fold structures south and east of the Great Island Basin.

In the Tadoule-Wither Lake area Great Island Group rocks are deformed by east- to northeast-trending folds (F_1). Primary layering is highly attenuated and boudinaged. A zone of cataclastic aplite and remobilized basement rock truncates the north flank of an F_1 synform along Seal River to the west of Great Island. This zone delineates the boundary between the Great Island Domain and the Seal River Domain. The F_1 folds are terminated to the east and separated from the Great Island basin by quartz monzonite and a northwest-trending shear zone.

The Great Island basin is interpreted as a complex system of basins and domes that formed as a result of F_2 folds that deformed earlier F_1 folds about north- to northwest-trending fold axes.

South and east of the Great Island basin deformation produced east-trending F_1 folds that predate the intrusion of a younger phase of shearing, faulting and associated F_2 folds.

MINERALIZATION

Gold mineralization was first reported in the area by Johnson (1936) on the north channel of the Seal River, 4.8 km downstream from the west end of Great Island (Fig. 46, location SR1). A 9.2 m wide shear zone contains numerous quartz stringers and pyrite that returned traces of gold when assayed.

Milligan (1955) reported a second occurrence 19 km to the east (Fig. 46, location SR2). A grab sample of a quartz vein in garnet amphibolite schist contained trace amounts of gold. Diamond drilling carried out in the area in the 1950s did not intersect any signigicant mineralization; however, holes drilled just southwest of Great Island intersected sulphides, including arsenopyrite (Manitoba Mines Branch, Non-confidential Assessment Files, 90180-90185).

Manitoba Mineral Resources Ltd. carried out a base metal exploration program in the lower Seal River area from 1975 to 1979. A sample from diamond drill hole 133-24 assayed 4.11 g/tonne (0.12 oz/ton) gold from 41.79 to 43.19 m and 3.77 g/tonne (0.11 oz/ton) gold from 43.62 to 45.14 m (Fig. 46, location SR3). The mineralized section is composed of dacite tuff with numerous siliceous laminae and massive bands of pyrrhotite (Manitoba Mines Branch, Non-confidential Assessment File, 92117).

Dredge and Nielsen (1986) reanalyzed 26 till samples that were collected during the course of geological mapping of Quaternary deposits and these were found to have anomalous arsenic values. They reported that gold values well above 5 ppb were detected in six of these samples (Fig. 46). In 1986 additional till sampling was undertaken in the area of the highest anomaly, 5 km east of Great Island, to determine its source. A well defined dispersion train was defined using arsenic and gold analyses of the less than 2 micron fraction and less than 63 micron fraction (Nielsen, 1987). The source of the anomaly appears to be a mineralized outcrop located at the up-ice end of the dispersion train.

In 1986 two permits to explore for minerals were granted in the Great Island area. The first, which covers an area of 48 851 ha north of Great Island, is held by R.A. Dickinson and is being explored by joint venture partners High D'or Developments Ltd. and North American Metals Corp. Reconnaissance geological and geochemical surveys undertaken during the summer of 1986 located stratabound arsenopyrite-rich gold mineralization associated with chemically precipitated sediments and intermediate volcanic tuffs (Northwest Prospector Miners and Developers Bulletin, February/March, 1987). Samples of mineralization from very sparse outcrop returned assays of up to 19.89 g/tonne (0.58 oz/ton) gold. Diamond drilling commenced on the property in February 1987. The second permit, which covers an area of 40 488 ha northeast of Great Island, is held by Kidd Creek Mines Limited.

REFERENCES

Alcock, F.J.
1917: Wekusko Lake area, northern Manitoba; **in** Geological Survey of Canada, Summary Report, 1917, Part D, p. 8-16.
1919: Wekusko Lake area, Manitoba; **in** Geological Survey of Canada, Summary Report, 1918, Part D, p. 9-10.
1920a: Cross-Pipestone map-area, Manitoba; **in** Geological Survey of Canada, Summary Report 1919, Part D.
1920b: The Reed-Wekusko map-area Northern Manitoba; Geological Survey of Canada, Memoir 119, 47 p.

Amukun, S.E.
1969: Petrology of the gold-bearing vein rocks from Manitoba; University of Manitoba, unpublished M.Sc. thesis, 136 p.

Armstrong, P.
1922: Geology and ore deposits of Elbow Lake area, northern Manitoba; **in** Geological Survey of Canada, Summary Report 1922, Part C., p. 37-44.

Ashton, K.E. and Wheatley, K.J.
1986: Preliminary report on the Kisseynew gneisses in the Kisseynew-Wildnest Lakes area, Saskatchewan; **in** Current Research, Part B, Geological Survey of Canada, Paper 86-1B, p. 305-317.

Ashton, K.E., Wheatley, K.J., Moser, D., Paul, D. and Wilcox, K.H.
1986: The Kisseynew gneisses of Saskatchewan: Update; **in** Summary of Investigations 1986, Saskatchewan Geological Survey; Saskatchewan Energy and Mines, Miscellaneous Report, 86-4, p. 145-148.

Augsten, B.E.K.
1985: Ore mineralogy of the Agassiz stratiform gold deposit, Lynn Lake region, Manitoba; Carleton University, unpublished B.Sc. thesis, 36 p.

Augsten, B.E.K., Thorpe, R.I., Harris, D.C. and Fedikow, M.A.F.
1986: Ore mineralogy of the Agassiz (MacLellan) gold deposit in the Lynn Lake region, Manitoba; Canadian Mineralogist, v. 24, p. 369-377.

Ayres, L.D.
1978: A transition from subaqueous to subaerial eruptive environments in the middle Precambrian Amisk Group at Amisk Lake, Saskatchewan — a progress report; **in** Centre for Precambrian Studies, University of Manitoba, 1977 Annual Report, p. 36-51.

Bailes, A.H.
1969: Geology and geochemistry of the Pilot-Smuggler shear zone, Rice Lake area, Manitoba; University of Manitoba, unpublished M.Sc. thesis.
1971: Preliminary compilation of the geology of the Snow Lake-Flin Flon Sherridon area; Manitoba Mines Branch, Geological Paper 1/71, 27 p.
1975: Geology of the Guay-Wimapedi Lakes area; Manitoba Mineral Resources Division, Publication 75-2.
1980: Geology of the File Lake area; Manitoba Mineral Resources Division, Geological Report 78-1, 134 p.
1985: Geological investigations in the Chisel Lake-Reed Lake area; **in** Manitoba Energy and Mines, Mineral Resources Division, Report of Field Activities 1985, Report GS-11, p. 48-50.
1986: Chisel-Morgan Lakes project; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-15, p. 71-76.

Bailes, A.H. and McRitchie, W.D.
1978: The transition from low to high grade metamorphism in the Kisseynew sedimentary gneiss belt, Manitoba; **in** Metamorphism in the Canadian Shield (A. Fraser and W.W. Heywood, eds.); Geological Survey of Canada, Paper 78-10, p. 155-177.

Bailes, A.H., and Syme, E.C.
1979: White Lake-Mikanagan Lake project; **in** Manitoba Mineral Resources Division, Report of Field Activities 1979, Report GS-12, p. 46-54.
1980: White Lake-Mikanagan Lake project (parts of 63 K/12 and 13); **in** Manitoba Mineral Resources Division, Report of Field Activities 1980, Report GS-9, p. 43-50.
1981: White Lake/Mikanagan Lake Project (parts of 63 K/12 and 13); **in** Manitoba Mineral Resources Division, Report of Field Activities 1981, Report GS-9, p. 37-38.
1982: Flin Flon-Schist Lake areas (parts of 63 K/12, 13); **in** Manitoba Mineral Resources Division, Report of Field Activities 1982, Report GS-5, p. 15-18.
1983: Flin Flon-Schist Lake project (parts of 63 K/12, 13); **in** Manitoba Department of Energy and Mines, Mineral Resources Division, Report of Field Activities 1983, Report GS-5, p. 15-22.
1984: Geological investigations in the Flin Flon area; **in** Manitoba Energy and Mines, Mineral Resources Division, Report of Field Activities 1984, Report GS-11, p. 37.

Bailes, A.H. Syme, E.C., Galley, A.G. and Skirrow, R.G.
1987: Early Proterozoic volcanism, hydrothermal activity and associated ore deposits at Flin Flon and Snow Lake, Manitoba; Field trip guidebook, Geological Association of Canada/Mineralogical Association of Canada, Joint Annual Meeting, Saskatoon, Saskatchewan.

Baker, W.F.
1935: Geology of God's Lake Gold Mines Limited; Transactions of the Canadian Institute of Mining and Metallurgy, v. 38, p. 155-162.

Baldwin, D.A.
1974: Geology of the Kadeniuk Lake area; **in** Summary of Geological Fieldwork; Manitoba Mineral Resources Division, Geological Paper 2/74, p. 10-12.
1980: Porphyritic intrusions and related mineralization in the Flin Flon volcanic belt; Manitoba Mineral Resources Division, Economic Geology Report ER79-4, 23 p.

Baldwin, D.A., Frohlinger, T.G., Kendrick, G., McRitchie, W.D., and Zwanzig, H.V.
1979: Geology of the Nelson House-Pukatawagan region (Burntwood Project); Manitoba Mineral Resources Division, Geological Maps 78-3-1 to 78-3-22.

Baldwin, D.A., Parbery, D., Boden, S., and Michielsen, A.
1985: Mineral deposit studies in the Lynn Lake and Barrington Lake areas; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1985, Report GS-24, p. 20-28.

Baldwin, D.A., Syme, E.C., Zwanzig, H.V., Gordon, T.M., Hunt, P.A., and Stevens, R.D.
1985: U-Pb zircon ages from the Lynn Lake and Rusty Lake metavolcanic belts, Manitoba: two ages of Proterozoic magmatism; Geological Association of Canada/Mineralogical Association of Canada, Annual Meeting, Fredericton, Program with Abstracts, v. 10, p. A3.

Bamburak, J.D.
1980: Mineral inventory of Manitoba; Manitoba Department of Energy and Mines, Mineral Resources Division, Economic Geology Report ER79-6, 41 p.

Baragar, W.R.A., and Scoates, R.F.J.
1980: The circum-Superior belt: A Proterozoic plate margin?; **in** Precambrian Plate Tectonics, (A. Kroner, ed.); Elsevier Science Publishing Co. Inc., 782 p.

Barry, G.S.
1961: Geology of the Gods Narrows area; Manitoba Mines Branch, Publication 60-1, 33 p.
1965: Geology of the Trophy Lake area (east half); Manitoba Mines Branch, Publication 63-3, 47 p.

Bateman, J.D.
1945: McVeigh Lake area, Manitoba; Geological Survey of Canada, Paper 45-14, 34 p.

Bateman, J.D. and Harrison, J.M.
1945: Mikanagan Lake, Manitoba; Geological Survey of Canada, Map 832A with descriptive notes.
1946: Sherridon, Manitoba; Geological Survey of Canada, Map 862A with descriptive notes.

Bell, C.K.
1971: History of the Superior-Churchill boundary in Manitoba; Geological Association of Canada, Special Paper, No. 9, p. 11-39.

Blackburn, C.E., Bond, W.D., Breaks, F.W., Davis, D.W., Edwards, G.R., Poulsen K.H., Trowell, N.F., and Wood, J.
1985: Evolution of Archean volcanic-sedimentary sequences of the western Wabigoon Subprovince and its margins: a review; **in** Geological Association of Canada, Special Paper 28, p. 89-116.

Brooks, C., Ludden, J., and Pigeon, Y.
1982: Volcanism of shoshonite to high-K andesite affinity in an Archean arc environment, Oxford Lake, Manitoba; **in** Canadian Journal of Earth Sciences, v. 19, p.55-67.

Brooks, C. and Theyer, P.
1981: Rb-Sr geochronology in the Thompson belt, Manitoba: implications for Aphebian crustal development and metallogenesis; **in** Canadian Journal of Earth Sciences, v. 18, no. 5, p. 932-943.

Brown, A.
in prep: Geology of the Hole River — Black Island — Rice River area; Geological Survey of Canada, Paper (in preparation).

Brownell, S.M.
1931: Report on the Gem Lake Mines Limited; Manitoba Energy and Mines, Mines Branch, Corporation File, Gem Lake Mines Limited.
1941: Geology of the Falcon Lake Stock, southeastern Manitoba; Canadian Institute of Mining and Metallurgy Transactions, 44, p. 230-250

Bruce, E.L.
1916: Amisk-Athapapuskow Lake area, northern Saskatchewan and northern Manitoba; Geological Survey of Canada, Department of Mines, Summary Report, 1915, p. 130.
1918: Amisk-Athapapuskow Lake district; Geological Survey of Canada, Memoir 105, 91 p.
1919: Gold-quartz veins and scheelite deposits in southeastern Manitoba; **in** Geological Survey of Canada, Summary Report, 1918, Part D, p. 2-5.

Burwash, R.A., Badsgard, H., and Peterman, Z.E.
1962: Precambrian K-Ar dates from the Western Canada sedimentary basin; **in** Journal of Geophysical Research, v. 67, no.4, p. 1617-1625.

Byers, A.R. and Dahlstrom, C.D.A.
1954: Geology and mineral deposits of the Amisk-Wildnest Lakes area, Saskatchewan; Saskatchewan Department of Mineral Resources, Report 14, 177 p.

Campbell, C.A.
1947: Report on Gold Pan Mines (1945) Limited; Manitoba of Energy and Mines, Mines Branch, Corporation File, Gold Pan Mines (1945) Limited.

Campbell, F.H.A.
1971: Stratigraphy and sedimentation of part of the Rice Lake group, Manitoba; **in** Geology and Geophysics of the Rice Lake region, Southeastern Manitoba (W.D. McRitchie and W. Weber, eds.); Manitoba Department of Mines and Natural Resources, Mines Branch, Geological Paper GP71-1, p. 135-183.
1972: Stratigraphic and structural studies in the Granville Lake-Lynn Lake region; Manitoba Mines Branch, Publication 71-2A, 40 p.
1972: Geology of the Turnbull Lake (west half) area; Manitoba Mines Branch, Publication 71-2D, 39 p.

Clark, G.S.
1980: Rubidium-strontium geochronology in the Lynn Lake greenstone belt, northwestern Manitoba; Manitoba Department of Energy and Mines, Mineral Resources Division, Geological Paper GP80-2, 9 p.
1981: Rubidium-strontium geochronology in the Churchill structural province, northern Manitoba; **in** Manitoba Mineral Resources, Report of Field Activities 1981, p. 97-98.

Clark, G.S., Anderson, R. and McRitchie, W.D.
1974: Total rock Rb-Sr ages from the Burntwood area; **in** Centre for Precambrian Studies, University of Manitoba, Annual Report 1974, Part 2, Research, p. 51-52.

Clark, G.S., and Cheung, S.P.
1977: Rubidium-strontium whole-rock ages from the Oxford Lake-Knee Lake greenstone belt,northeastern Manitoba; University of Manitoba, Centre for Precambrian Studies, Annual Report, 1977, p. 106-121.

Cole, G.E.
1927: The development in gold mining in Canada; Second (Triennial) Empire Mining and Metallurgical Congress, Winnipeg, p. 63-64.
1942 Manitoba Energy and Mines, Mines Branch, Unpublished Information File (63 J/13).

Cooke, H.C.
1921: Geology and mineral resources of Rice Lake and Oiseau River areas, Manitoba; **in** Geological Survey of Canada, Summary Report, 1921, Part C, p. 33.

Corkery, M.T.
1983: Cross Lake supracrustal investigation; **in** Manitoba Mineral Resources Division, Report on Field Activities, 1983, Report GS-7, p. 32-45.
1985a: Cross Lake supracrustal investigation in the eastern Pipestone Lake area; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1985, Report GS-32, p. 165-172.

1985b Geology of the lower Nelson River project area; Manitoba Energy and Mines, Geological Services, Geological Report GR82-1, 66 p.

Corkery, M.T. and Lenton, P.G.

1984: Cross Lake supracrustal investigations; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-28, p. 107-109.

Cumming, G.L., Eckstrand, O.R. and Peredery, W.V.

1982: Geochronologic interpretations of Pb isotope ratios in nickel sulfides of the Thompson belt, Manitoba; **in** Canadian Journal of Earth Sciences, v. 19, no. 12, p. 2306-2324.

Dahlstrom, C.D.A

1949: Report on the Farley Lake group; Manitoba Energy and Mines, Mines Branch, Non-confidential Assessment File (91041).

Davies, J.F.

1949: Geology of the Wanipigow Lake area; Manitoba Department of Mines and Natural Resources, Mines Branch, Preliminary Report 48-2, 14 p.

1950: Geology of the Wanipigow River area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 49-3, 21 p.

1953: Geology and gold deposits of southern Rice Lake area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 52-1, 41 p.

1954: Geology of the West Hawk Lake-Falcon Lake area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 53-4, 28 p.

1963: Geology and gold deposits of the Rice Lake-Wanipigow River area, Manitoba; University of Toronto, unpublished Ph. D. thesis, 142 p.

Davies, J.F., Bannatyne, B.B., Barry, G.S., and McCabe, H.R.

1962: Geology and mineral resources of Manitoba; Manitoba Department of Mines and Natural Resources, Mines Branch, MRD 2, 190 p.

Dawson, C.B.

1937: Gurney Gold Mines Limited; Manitoba Energy and Mines, Mines Branch, Corporation File, Gurney Gold Mines Limited.

1950: Report on the property of Falnora Gold Mines Limited; Manitoba Department of Energy and Mines, Mines Branch, Non-confidential Assessment File (91070).

DeLury, J.S.

1920: Mineral prospects in southeast Manitoba, Rice Lake, Maskwa River, and Boundary districts; Manitoba Government Bulletin, p. 33.

1921: Mineral prospects in southeastern Manitoba; Manitoba Bulletin, p. 22-23.

1927: The mineral resources of southeastern Manitoba, Rice Lake district, Oiseau River district and Boundary district; Industrial Development Board of Manitoba, 55 p.

Dewey, J.F., and Burke, K.C.A.

1973: Tibetan, Variscan and Precambrian basement reactivation: products of continental collision; Journal of Geology, v. 81, p. 683-692.

De Wet, J.P.

1936: Mining in Manitoba during 1935; **in** Canadian Mining Journal, February 1936, p. 77-78.

Dix, W.F.

1951: Geology of the Gods Lake area; Manitoba Mines Branch, Publication 47-4, 7 p.

Dredge, L.A., and Nielsen, E.

1986: Gold concentrations in till, Great Island, northern Manitoba; **in** Current Research, Part A, Geological Survey of Canada, Paper 86-1A, p. 779-782.

Dresser, J.A.

1917: Gold bearing districts of southeastern Manitoba; **in** Geological Survey of Canada, Summary Report 1916, p. 169-174.

Eakins, P.R.

1949: Geology of the Jeep Mine, Rice Lake area, southeastern Manitoba; McGill University, unpublished M.Sc. thesis, 28 p.

Ebbutt, F.

1944: The Nor-Acme property of the Howe Sound Exploration Company; The Precambrian, v. 17, no. 7, p. 6-11.

Eccles, D.R. and Fedikow, M.A.F.

1985: Mineral occurrence documentation and alteration zone mapping, Snow Lake area; **in** Manitoba Department of Energy and Mines, Mineral Resources Division, Report of Field Activities 1985, Report GS-20, p. 82-99.

Elphick, S.C.

1972: Geology of the Mynarski-Notigi Lakes Area; Manitoba Department of Mines, Resources and Environmental Management, Mines Branch, Publication 71-2C, 48 p.

Ermanovics, I.F.

1970: Precambrian geology of Hecla-Carroll Lake map area, Manitoba-Ontario; Geological Survey of Canada, Paper 69-42, 33 p.

Farquharson, R.B., and Clark, G.S.

1971: Rb-Sr geochronology of some granitic rocks in southeastern Manitoba; **in** Geological Association of Canada, Special Paper Number 9, p. 111-117.

Fedikow, M.A.F.

1981: Mineral deposit studies-Superior Province-Southeastern Manitoba; **in** Manitoba Department of Energy and Mines, Mineral Resources Division, Report of Field Activities 1981, Report GS-15, p. 64-73.

1983: Geological and geochemical investigations at the Agassiz Au-Ag deposit, Lynn Lake, Manitoba; **in** Manitoba Department of Energy and Mines, Geological Services Branch, Report of Field Activities 1983, Report GS-15, p. 94-97.

1984: Preliminary results of biogeochemical studies in the Lynn Lake area; Manitoba Department of Energy and Mines, Mineral Resources Division, Open File Report OF84-1, 104 p.

1986a: Geology of the Agassiz stratabound Au-Ag deposit, Lynn Lake, Manitoba; Manitoba Energy and Mines, Geological Services, Open File Report OF85-5, 79 p.

1986b: The Agassiz metallotect-Spider Lake area; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-5, p. 23-25.

1986c: Manitoba Energy and Mines, Minerals Division, Open House, November 19-20, Winnipeg, Manitoba, Poster Display.

Fedikow, M.A.F., Baldwin, D.A. and Taylor, C.

1986a: Gold mineralization associated with the Agassiz metallotect and the Johnson Shear Zone, Lynn Lake greenstone belt, Manitoba; **in** Gold in the Western Shield Symposium (L.A. Clark, ed.); Canadian Institute of Mining and Metallurgy, Special Volume 38, 1986, p. 361-377.

Fedikow, M.A.F., and Gale, G.H.

1982: Mineral deposit studies in the Lynn Lake area; **in** Manitoba Department of Energy and Mines, Geological Services Branch, Report of Field Activities 1982, Report GS-8, p. 58-59.

Fedikow, M.A.F., Kramarchuk, B. and Charlesworth, R.B.
1984: Geochemical studies along the Agassiz metallotect: **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-9, p. 29-31.

Fedikow, M.A.F., Roney, C.T., Schmidt, G.J., and Robbie, T.J.
1986b: Mineral deposit studies in the Snow Lake area: **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-16, p. 77-85.

Ferreira, K.
1986a: Geological investigations in the Sheila Lake-Margaret Lake area; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-2, p. 13-17.
1986b: Geological investigations in the Foster Lake-Wasekwan Lake area:**in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report, GS-3, p. 13-17.

Fingler, J.L.
1985: Progress report on a study of the mineralization related to the Falcon Lake intrusive complex, southeastern Manitoba; University of Manitoba, Department of Geological Sciences, progress report on M.Sc. thesis, 44 p.
1986: Progress report on a study of the mineralization related to the Falcon Lake intrusive complex, southeastern Manitoba; University of Manitoba, Department of Geological Sciences, progress report on M.Sc. thesis, 46 p.

Fountain, D.M., and Salisbury, M.H.
1981: Exposed cross-sections through the continental crust: implications for crustal structure, petrology, and evolution: **in** Earth and Planetary Science Letters, no. 56, p. 263-277.

Fox, J.S.
1976: Some comments on the volcanic stratigraphy and economic potential of the West Amisk Lake area, Saskatchewan: Geological Association of Canada/Mineralogical Association of Canada, Annual Meeting, Edmonton, Program with Abstracts.

Franklin, J.M. and Thorpe, R.I.
1982: Comparative metallogeny of the Superior, Slave and Churchill Provinces: **in** Precambrian Sulphide Deposits, H.S. Robinson Memorial Volume (R.W. Hutchinson, C.D. Spence and J.M. Franklin, eds.); Geological Association of Canada, Special Paper 25, p. 3-90.

French, A.G.
1915: Penniac Reef Gold Mines Ltd.: Manitoba Energy and Mines, Corporation File, Penniac Reef Gold Mines, Ltd.

Froese, E.
1985: Anthophyllite-bearing rocks in the Flin Flon-Sherridon area, Manitoba; **in** Current Research, Part B, Geological Survey of Canada, Paper 85-1B, p. 541-544.

Froese, E. and Gasparrini, E.
1975: Metamorphic zones in the Snow Lake area, Manitoba; Canadian Mineralogist, v. 13, p. 162-167.

Froese, E. and Goetz, P.A.
1981: Geology of the Sherridon Group in the vicinity of Sherridon, Manitoba; Geological Survey of Canada, Paper 80-21.

Froese, E., and Moore, J.M.
1980: Metamorphism in the Snow Lake area, Manitoba; Geological Survey of Canada, Paper 78-27, 16 p.

Fyon, J.A., Crocket, J.H., and Schwartz, H.P.
1983: The Carshaw and Malga iron-formation-hosted gold deposits of the Timmins area: **in** The Geology of Gold in Ontario; Ontario Geological Survey, Miscellaneous Paper 110, p. 98-110.

Gaba, R.G.
1984 Geology of the Gatlan area, Wallace Lake; Manitoba Energy and Mines, Geological Services Branch, Preliminary Map 1984R-2.
1985: Mineral deposit investigations in the Wallace Lake-Siderock Lake area: **in** Manitoba Energy and Mines, Report of Field Activities, 1985, Report GS-29, p. 148-151.

Gaba, R.G. and Theyer, P.
1984: The Gatlan gold occurrence, Wallace Lake; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-25, p. 100-101.

Gale, G.H.
1980: Mineral Deposit Studies — Flin Flon Kisseynew; **in** Manitoba Mineral Resources Division, Report of Field Activities 1980, p. 51-64.
1981: Mineral deposit studies in the Flin Flon area: **in** Manitoba Department of Energy and Mines, Mineral Resources Division; Report of Field Activities 1981, Report GS-12, p. 45-51.
1983: Mineral Deposit investigations in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report on Field Activities, 1983, Report GS-13, p.84-87.

Gale, G.H., Baldwin, D.A. and Koo J.
1980: A geological evaluation of Precambrian massive sulphide deposit potential in Manitoba; Manitoba Department of Energy and Mines, Mineral Resources Division, Economic Geology Report ER79-1, 137 p.

Gale, G.H. and Ostry, G.
1984: Stratabound gold mineralization in the Kisseynew gneiss terrain; **in** Manitoba Energy and Mines, Mineral Resources, Report of Field Activities 1984, Report GS-18, p. 73-80.

Galley, A.
1986: Setting of gold mineralization, Snow Lake, Manitoba; Manitoba Energy and Mines, Minerals Division, Open House, November 19-20, Winnipeg, Manitoba, Poster Display.

Galley, A.G., Ames, D.E. and Franklin, J.M.
1985: Preliminary investigations of gold mineralization in the Flin Flon-Snow Lake belt, Manitoba and Saskatchewan; **in** Current Research, Part A, Geological Survey of Canada, Paper 85-1A, p. 761-771.

Galley, A.G., Ziehlke, D.V., Franklin, J.M., Ames, D.E., and Gordon, T.M.
1986: Gold mineralization in the Snow Lake-Wekusko Lake region, Manitoba; **in** Gold in the Western Shield (L.A. Clark, ed.); Canadian Institute of Mining and Metallurgy, Special Volume 38, p. 379-398.

Gibb, R.A.
1983: A model for suturing of Superior and Churchill plates: an example of double indentation tectonics; Geology, v. 11, p. 413-417.

Gibb, R.A., and Walcott, R.I.
1971: A Precambrian suture in the Canadian Shield; **in** Earth and Planetary Science Letters, No. 262, p. 417-422.

Gibbins, W.A.
1967: Geology of the Falcon Lake stock; Northwestern University, unpublished M.Sc. thesis, 133 p.
1971: Geology of the Falcon Lake stock, southeastern Manitoba; **in** Geological Association of Canada, Special Paper Number 9, p. 129-135.

Gibson, J.C., and Stockwell, C.H.
1948: San Antonio Mine; **in** Structural Geology of Canadian Ore Deposits, Canadian Institute of Mining and Metallurgy Symposium, p. 315-321.

Gilbert, H.P.
1985a: Geological investigation in the Island Lake-Stevenson Lake area; **in** Manitoba Energy and Mines, Geological Services, Report of Field Activities 1985, Report GS-38, p. 187-199.
1985b: Geology of the Knee Lake-Gods Lake area; Manitoba Energy and Mines, Geological Services, Geological Report GR83-1B, 76 p.

Gilbert, H.P., Syme, E.C., and Zwanzig, H.V.
1980: Geology of the metavolcanic and volcaniclastic metasedimentary rocks in the Lynn Lake area; Manitoba Energy and Mines, Mineral Resources Division, Geological Paper GP80-1, 118 p.

Godard, J.D.
1963: Geology of the Island Lake-York Lake area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 59-3, 45 p.

Gonzales, A. and Fedikow, M.
1984: Mineral deposit studies, Snow Lake area; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-13, p. 46-52.

Gordon, T.M.
1981: Metamorphism in the Crowduck Bay area, Manitoba; **in** Current Research, Part A, Geological Survey of Canada, Paper 81-1A, p. 315-316.

Gordon, T.M. and Gall, Q.
1982: Metamorphism in the Crowduck Bay area, Manitoba; **in** Current Research, Part A, Geological Survey of Canada, Paper 82-1A, p. 197-201.

Gordon, T.M., Hunt, P.A., Loveridge, W.D., Bailes, A.H. and Syme, E.C.
1987: U-Pb zircon ages from the Flin Flon and Kisseynew belts, Manitoba: chronology of early Proterozoic crust formation; **in** Geological Association of Canada/Mineralogical Association of Canada, Annual Meeting, Program with Abstracts, v. 12, p. 48.

Gordon, T.M., Jackson, S.L., and Zaleski, E.
1985: Metamorphic processes in the Kisseynew metasedimentary gneiss belt; **in** Current Research, Part A, Geological Survey of Canada, Paper 85-1A, Report 62, p. 511-516.

Green, A.G., Najnal, Z., and Weber, W.
1985: An evolutionary model of the western Churchill Province and western margin of the Superior Province in Canada and the north-central United States; **in**Tectonophysics, Volume 116, p. 281-322.

Hage, C.O.
1944: Geology of Gurney Gold Mine area, Manitoba; Precambrian, v. 17, no. 4, p. 5-7.

Halwas, D.
1984: The structure of the Sunbeam-Kirkland breccia pipe, southeastern Manitoba; unpublished B.Sc. thesis, University of Manitoba, 56 p.

Harrison, J.M.
1949: Geology and mineral deposits of File-Tramping Lakes area, Manitoba; Geological Survey of Canada, Memoir 250, 92 p.
1951a: Possible major structural control of ore deposits, Flin Flon-Snow Lake mineral belt, Manitoba; Canadian Mining and Metallurgy Institute, Transactions, v. 54, p. 4-8.
1951b: Precambrian correlation and nomenclature, and problems of the Kisseynew gneisses in Manitoba; Geological Survey of Canada, Bulletin 20, 53 p.

Haugh, I.
1962: A petrofabric study of the Falcon Lake stock, southern Manitoba; University of Manitoba, unpublished M.Sc. thesis, 85 p.
1969: Geology of the Split Lake area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 65-2, 87 p.

Heaman, L.M., Machado, N., Krogh, T.E. and Weber, W.
1986: Precise U-Pb zircon ages for the Molson dyke swarm and the Fox River Sill: Constraints for early Proterozoic crustal evolution in northeastern Manitoba, Canada; Contributions to Mineralogy and Petrology, v. 94, p. 82-89.

Hogg, N.
1957: The Nor-Acme Mine, **in** Structural Geology of Canadian Ore Deposits; Canadian Institute of Mining and Metallurgy, v. 2, p. 262.

Horwood, H.C.
1934: The Cross Lake map-area, Manitoba; Massachusetts Institute of Technology, unpublished Ph.D. thesis.

Hubregtse, J.J.M.W.
1985: Geology of the Oxford Lake-Carrot River area; Manitoba Energy and Mines, Geological Services, Geological Report, GR83-1A, 73 p.

Hunter, H.E.
1953: Geology of the McKnight Lake Area; Manitoba Mines Branch, Publication 52-3, 7 p.

Innes, M.J.S.
1960: Gravity and isostasy in northern Ontario and Manitoba, Geological Survey of Canada, Publications of the Dominion Observatory, Ottawa, XXI(6).

Jackson, S.L. and Gordon, T.M.
1985: Metamorphism and structure of the Laurie Lake region, Manitoba; **in** Current Research, Part A, Geological Survey of Canada, Paper 85-1A, p. 753-759.

Jeffrey, W.H.
1912: Report of the Penniac Reef Gold Mines Limited; Manitoba Energy and Mines, Mines Branch, Corporation File, Star Lake Gold Mines, Limited.

Johnston, A.W.
1936: Seal River area, northern Manitoba; Geological Survey of Canada, Paper 35-2, 3 p.

Kalliokoski, J.
1953: Interpretations of the structural geology of the Sherridon-Flin Flon region, Manitoba; Geological Survey of Canada, Bulletin 25, 18 p.

Keays R.R., and Scott, R.B.
1976: Precious metals in ocean-ridge basalts: implications for basalts as source rocks for gold mineralization; Economic Geology, v. 71, p. 705-720.

Kelley, L.I.
1986: Overview of SherrGold exploration projects Lynn Lake belt; Sherritt Gordon Mines, communication.

Kornik, L.J.
1968: Geology of the Guay Lake Area (west half); Manitoba Mines Branch, Publication 64-6., 19 p.

Kreczmer, M.J. and Deveaux, P.J.
1986: Exploration and geology of Tartan Lake and Puffy Lake deposits, Flin Flon area, Manitoba; **in** Gold in the Western Shield (L.A. Clark, ed.); The Canadian Institute of Mining and Metallurgy, Special Volume 38, p. 359-360.

Lamb, C.F.
1975: Southeastern Manitoba; **in** Manitoba Mineral Resources Division, Summary of Geological Fieldwork, Geological Paper 2/75, p. 38-39.

Lenton, P.G.
1981: Geology of the McKnight-McCallum Lakes area, Manitoba Mineral Resources Division, Geological Report GR79-1, 39 p.

Little, H.W.
1959: Tungsten deposits of Canada (with reference to Manitoba); Geological Survey of Canada, Economic Geology Report 17, p. 147-157.

Mandziuk, W.C., Brisbin, W.C., and Scoates, R.F.J.
1986: The Falcon Lake igneous complex, southeastern Manitoba; **in** Layered Intrusions of Southeastern Manitoba and Northwestern Ontario; GAC, MAC, CGU Field Trip 13 Guidebook, Section B, p. 21-36

Marr, J.
1970: Petrology of the northern granitic rocks Wanipigow River; University of Manitoba, unpublished M.Sc. thesis, 92 p.

Marten, B. and Gilbert, H.P.
1973: Gods Lake (marginal notes); Manitoba Department of Mines, Resources and Environmental Management, Preliminary Map 1973-H9.

McGlynn, J.C.
1959: Elbow-Hemming Lakes area, Manitoba; Geological Survey of Canada, Memoir 305, 72 p.

McMurchy, R.C.
1944: Geology of the Island Lake area of Manitoba; **in** The Precambrian, September 1944, p. 4-9.

McRitchie, W.D.
1969: Project pioneer; **in** Manitoba Mines Branch, Summary of Geological Fieldwork, 1969, p. 107-114.
1971a: Geology of the Wallace Lake-Siderock Lake area, 1968-1969; 1 inch to 1 mile; Manitoba Mines Branch, Map 71-1/6 (to accompany Publication 71-1).
1971b: The Petrology and environment of the acidic plutonic rocks of the Wanipigow-Winnipeg Rivers region, southeastern Manitoba; **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D. McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, p. 7-62.
1971b: Geology of the Wallace Lake-Siderock Lake area: a reappraisal; **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D.McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, p. 107-126.
1974 The Sickle-Wasekwan Debate: A Review; Manitoba Mines Branch, Geological Paper 74-1, 23 p.
1977: Reindeer Lake-Southern Indian Lake; **in** Manitoba Mineral Resources Division, Report of Field Activities 1977, p. 13-18.
1985: Kisseynew Project: Geological reconnaissance of Kisseynew lake West (63K/13 NW); **in** Manitoba Energy and Mines, Report of Field Activities 1985, p. 57-63.
1986: Kisseynew Project: Geological reconnaissance of Kisseynew Lake west; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, p. 96-99.

McRitchie, W.D., Frohlinger, T.G., Baldwin, D.A. and Zwanzig, H.V.
1972: Burntwood Project; **in** Summary of Geological Fieldwork 1972; Manitoba Mines Branch, Geological Report 3/72, p. 20-25.

McRitchie, W.D., Peters, J. and Frohlinger, T.G.,
1979: History of exploration and geological work in the Nelson House-Pukatawagan region (Burntwood Project); Manitoba Mineral Resources Division, Geological Report 78-3 (Part II), 40 p.

McRitchie, W.D., and Weber, W.
1971: Metamorphism and deformation of the Manigotagan Gneissic Belt, southeastern Manitoba; **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D.McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, p. 235-284.

Milligan, G.C.
1955: Reconnaissance of the lower Seal River; Manitoba Mines Branch, Summary Report 55-4, 5 p.
1960: Geology of the Lynn Lake district; Manitoba Mines Branch, Publication 57-1, 317 p.

Moore, J.M. and Froese, E.
1972: Geological setting of the Snow Lake area; **in** Report of Activities, Part B, Geological Survey of Canada, Paper 72-1B, p. 78-81.

Mukherjee, A.C.
1971: The Precambrian geology of the Flin Flon area, northern Saskatchewan and Manitoba, Canada; University of Saskatchewan, Unpub. Ph.D. thesis.

Mukherjee, A.C., Stauffer, M.R. and Baadsgaard, H.
1971: The Hudsonian orogeny near Flin Flon, Manitoba: a tentative interpretation of Rb/Sr and K/Ar ages; Canadian Journal of Earth Sciences, v. 8, p. 939-946.

Nielsen, E.
1983: Overburden sampling in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities 1983, Report GS-16, p. 98-100.
1987: Till geochemistry of the Seal River area, east of Great Island, Manitoba; Manitoba Energy and Mines, Geological Services, Open File Report OF87-1, 28 p.

Neale, K.L.
1984: Bigstone Lake project; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, Report GS-33, p. 126-128.

Newman W.R.
1947: Geological report on the Gold Pan Mines; **in** Manitoba Energy and Mines, Mines Branch, Corporation File, Gold Pan Mines (1945) Limited.

Norman, G.W.H.
1934: Granville Lake district, northern Manitoba; Geological Survey of Canada, Summary Report, 1933, Part C, p. 23-41.

Ostry, G.
1984: Mineral occurrence studies in the File Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, Report GS-14, p. 53-59.
1986: Mineral investigations in the Kisseynew gneiss terrain; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-20, p. 100-106.

Parbery, D. and Gale, G.H.
1984: Mineral deposit investigations in the Flin Flon area; **in** Manitoba Energy and Mines, Geological Services, Report of Field Activities 1984, Report GS-15, p. 60-66.

Parbery, D.
1986: Mineral occurrence studies-Flin Flon area; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-10, p. 49-55.

Parslow, G.R.
1986: Kisseynew metallotect geochemical study; **in** Summary of Investigations 1986, Saskatchewan Geological Survey; Saskatchewan Energy and Mines, Miscellaneous Report 86-4, p. 84-96.

Parslow, G.R.
1986: Kisseynew metallotect geochemical study; **in** Summary of Investigations 1986, Saskatchewan Geological Survey; Saskatchewan Energy and Mines, Miscellaneous Report 86-4, p 84-96.

Parslow, G.R. and Gaskarth, W.J.
1985: Kisseynew metallotect geochemical study; **in** Summary of Investigations 1985, Saskatchewan Geological Survey; Saskatchewan Energy and Mines, Miscellaneous Report 85-4, p 50-58.

Parsons, C.S.
1932a: The treatment of gold ores from the English Brook area, Rice Lake district:**in** Canada Department of Mines, Investigations in Ore Dressing and Metallurgy, 1930, Report 376, p. 164-169
1932b: The recovery of gold from the ore of Ventures Limited, Island Lake property, Manitoba; **in** Canada Department of Mines, Investigations in Ore Dressing and Metallurgy, 1930, Report 454, p. 144-147.
1937: Gold ore from Laguna gold mine; **in** Investigations in Ore Dressing and Metallurgy; Mines and Geology Branch of Canada, Publication 771, Report 660, p. 184-187.

Pearson, D.E.
1972: The location and structure of the Precambrian Kisseynew Gneiss domain of northern Saskatchewan; Can. J. Earth Sci., v.9, p.1235-1249.

Peck, D.C.
1984: An investigation of gold mineralization at Cartwright Lake, Manitoba; **in** Manitoba Energy and Mines, Mineral Resources Division, Report of Field Activities 1984, Report GS-8, p. 24-28.
1985: Geological investigations at Cartwright Lake, Manitoba; **in** Manitoba Energy and Mines, Geological Services, Report of Field Activities 1985, Report GS-8, p. 37-40.
1986: The geology and geochemistry of the Cartwright Lake area: Lynn Lake greenstone belt, northwestern Manitoba; University of Windsor, unpublished M.Sc. thesis, 270 p.

Peloquin, S., and Gale, G.H.
1985: Geological setting of the Tartan Lake gold deposit; **in** Manitoba Energy and Mines, Geological Services, Report of Field Activities 1985, Report GS-16, p. 71-73.

Peloquin, S., Ostry, G., and Gale, G.H.
1985: Investigations of mineral occurrences in the Kisseynew metasedimentary terrain; **in** Manitoba Energy and Mines, Geological Services, Report of Field Activities Report GS-15, p. 64-70.

Peloquin, S., Tannahill, B. and Gale, G.H.
1986: Geology of the Tartan Lake gold deposit; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-11, p. 56-64.

Phillips, G.N., Groves, D.I., and Martin, J.E.
1984: An epigenetic origin for Archean banded iron-formation-hosted gold deposits; **in** Economic Geology, v. 79, p. 162-171.

Podolsky, T.
1951: Cranberry Portage (east half), Manitoba; Geological Survey of Canada, Preliminary Map 51-17 with marginal notes.

Pollock, G.D.
1964: Geology of the Duval Lake area; Manitoba Mines Branch, Publication 61-6, 59 p.
1965: Geology of the Russick Lake area; Manitoba Mines Branch, Publication 63-2, 37 p.

Poulsen, K.H., Ames, K.E., Lau, S. and Brisbin, W.C.
1986: Preliminary report on the structural setting of gold in the Rice Lake area, Uchi Subprovince, southeastern Manitoba; **in** Current Research, Part A, Geological Survey of Canada, Paper 86-1A, p. 213-220.

Price, D.
1977: Flin Flon, Snow Lake geology; Canadian Institute of Mining and Metallurgy field trip guidebook, Hudson Bay Mining and Smelting Co. Ltd., Flin Flon, Manitoba, 55 p.

Quinn, H.A.
1955: Nelson House, Manitoba; Geological Survey of Canada, Preliminary Map 54-13 with marginal notes.

Quinn, H. A. and Currie, K.L.
1961: Oxford House sheet; Geological Survey of Canada, Preliminary Map 21-1961.

Reid, J.A.
1923: The Apex group of claims Herb Lake, Manitoba; Manitoba Energy and Mines, Mines Branch, Unpublished Information File (63 J/13SW).
1935: Report on The Vanson Manitoba Gold Mines Limited; **in** Manitoba Energy and Mines, Mines Branch, Corporation File, Vanson Manitoba Gold Mines Limited.
1938: Report on the property of Laguna Gold Mines Limited; Manitoba Energy and Mines, Mines Branch, Corporation File, Laguna Gold Mines Limited.

Reid, J.A., and Dresser, J.A.
1925: Sampling of the Bingo Mine; **in** Canadian Mining Journal, v. 46, p. 472-473.

Robertson, D.S.
1951: The Kisseynew Lineament, northern Manitoba; The Precambrian, v. 24, p. 8-11, 13, 23.
1953: Batty Lake map-area, Manitoba; Geological Survey of Canada, Memoir 271, 55 p.

Robinson, A.H.A.
1935: Gold in Canada; Mines Branch, Ottawa, Publication 769, 127 p.

Rousell, D.H.
1966: Geology of the Cross Lake area; Manitoba Mines Branch, Publication 62-4, 69 p.

Russell, G.A.
1948: Geology of the Wallace Lake area; Manitoba Mines Branch, Preliminary Report 47-1, 15 p.
1949: Geology of the English Brook area; Manitoba Mines Branch, Preliminary Report 48-3, 22 p.
1952a: Structural studies of the Long Lake-Halfway Lake area; Manitoba Mines Branch, Publication 49-6, 10 p.
1952b: Geology of the Lily Lake-Kickley Lake Area; Manitoba Department of Mines and Natural Resources, Mines Branch, Publication 50-3, 16 p.
1957: Structural studies of the Snow Lake-Herb Lake area; Manitoba Mines Branch, Publication 55-3, 33 p.

Schledewitz, D.C.P.
1972: Geology of the Rat Lake Area; Manitoba Mines Branch, Publication 71-2B, 57 p.
1985: Kisseynew Project; Kississing Lake, Big Island-Yakushavich Island Region; **in** Manitoba Energy and Mines, Report of Field Activities 1985, Report GS-13, p. 54-56.
1986: Geology of the Cochrane and Seal Rivers area; Manitoba Energy and Mines, Minerals Division, Geological Report, GR80-9, 139 p.

Schledewitz, D.C.P. and Trembath, G.
1986: Kisseynew Project: Kississing Lake; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-18, p. 92-95.

Schmidtke, R.H.
1984: Mineral deposit documentation in the Bissett area; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, Report GS-24, p. 92-99.

Scoates, R.F.J.
1971: Ultramafic rocks of the Rice Lake greenstone belt; **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D. McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, p.189-202.
1981: Volcanic rocks of the Fox River belt, northeastern Manitoba; Manitoba Mineral Resources Division, Geological Report GR81-1, 109 p.

Seneshen D.M., and Owens, D.J.
1985: Geological investigations in the Stormy Lake area; in Manitoba Energy and Mines, Geological Services, Report of Field Activities 1985, Report GS-23, p. 112-120.
Shanks, R.J. and Bailes, A.H.
1977: "Missi Group" rocks, Wekusko Lake area: **in** Manitoba Mineral Resources Division, 1977 Report of Field Activities Report GS-16, p. 83-87.
Shepherd, F.D.
1935: Report on trip into Rice Lake and central Manitoba areas: Manitoba Energy and Mines, Mines Branch, Corporation File, Wingold Mines Ltd.
1939: The Gunnar Mine, Manitoba: **in** Canadian Institute of Mining and Metallurgy, v. 42, p. 406-415.
1943: Recent developments in the Snow-Herb Lake area: The Precambrian, November, 1943, p. 27.
Shklanka, R.
1967: Geology of the Bee Lake area, district of Kenora, Ontario: Ontario Department of Mines, Geological Report 47, 42 p.
Southard, G.G.
1977: Exploration history, compilation and review, including exploration data from cancelled assessment files, for the Gods, Knee and Oxford Lakes areas, Manitoba: Manitoba Mineral Resources Division, OF 77-5, 93 p.
Springer, G.D.
1952: Geology of the Rennie-West Hawk Lake area: Manitoba Mines Branch, Publication 50-6, 54 p.
Stanton, M.S.
1948: Geology of the Farley Lake area: Manitoba Mines Branch, Preliminary Report 47-5, 22 p.
Stauffer, M.R
1974: Geology of the Flin Flon area: A new look at the Sunless City; Geoscience Canada, v. 1, p. 30-35.
Stauffer, M.R. and Mukherjee, A.C.
1971: Superimposed deformations in the Missi meta-sedimentary rocks near Flin Flon, Manitoba: Canadian Journal of Earth Sciences, v. 8, p. 217-242.
Stauffer, M.R., Mukherjee, A.C. and Koo, J.
1975: The Amisk Group: an Aphebian island arc deposit: Canadian Journal of Earth Sciences, v. 12, p. 2021-2035.
Stephenson, J.F.
1971: Gold deposits of the Rice Lake-Beresford Lake greenstone belt, southeastern Manitoba: **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D. McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, p. 337-374.
1972: Gold deposits of the Rice Lake-Beresford Lake area, southeastern Manitoba: University of Manitoba, unpublished Ph.D. thesis, 294 p.
Stewart, J.W.
1977: Gold evaluation program; **in** Manitoba Mineral Resources Division, Report of Field Activities 1977, Report MEA-1, p. 105-108.
1980: Gold mines of Manitoba; Manitoba Mineral Resources Division, Educational Series ES80-1, 16 p.
Stewart, P.W., and Brewer, K.
1984: Mineral deposit studies in the western Lynn Lake greenstone belt; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-5, p. 17-19.
Stockwell, C.H.
1935: Gold deposits of the Elbow-Morton area, Manitoba: Geological Survey of Canada, Memoir 186, 74 p.
1937: Gold deposits of Herb Lake area, northern Manitoba; Geological Survey of Canada, Memoir 208, 46 p.
1938: Rice Lake-Gold Lake area, southeastern Manitoba: Geological Survey of Canada, Memoir 210, 79 p.
1945a: Beresford Lake (Marginal Notes); Geological Survey of Canada, Maps 809A, 810A and 811A.
1945b: McVeigh Lake area, Manitoba; Geological Survey of Canada, Paper 45-14, 34 p.
Stockwell, C.H., and Lord, C.S.
1939: Halfway Lake-Beresford Lake area, Manitoba: Geological Survey of Canada, Memoir 219, 66 p.
Syme, E.C.
1985a: Geochemistry of metavolcanic rocks in the Lynn Lake belt; Manitoba Energy and Mines, Geological Services, Geological Report GR 84-1, 84 p.
1985b: Athapapuskow Lake Project: **in** Manitoba Energy and Mines, Report of Field Activities 1985, Report GS-10, p. 44-47.
1986: Schist Lake area (Athapapuskow Project): **in** Manitoba Energy and Mines, Report of Field Activities 1986, Report GS-8, p. 36-42.
Syme, E.C., Bailes, A.H., Price, D.P. and Ziehlke, D.V.
1982: Flin Flon volcanic belt: Geology and ore deposits at Flin Flon and Snow Lake, Manitoba: Geological Association of Canada and Mineralogical Association of Canada Joint Annual Meeting, University of Manitoba, Winnipeg, Manitoba, 1982, Field Trip Guidebook No. 6, 91 p.
Tanton, T.L.
1937: Echimamish area, northern Manitoba; Geological Survey of Canada, Preliminary Report, Paper 37-18, 38 p.
1941: Flin Flon: Geological Survey of Canada, Map 632A with descriptive notes.
Theyer, P.
1978: Stratigraphic position of ultramafic lenses in the Island lake area: **in** Manitoba Mineral Resources Division, Report of Field Activities 1978, Report MEA-2, p. 106-108.
1980: Stratigraphic investigations of the Island, Stevenson-Ponask, Bigstone and Knight Lakes areas and of the Island Lake Gold Mine; **in** Manitoba Mineral Resources Division, Report of Field Activities 1980, Report GS-8, p. 38-42.
1981: Mineral deposit studies-Superior province: a) Island Lake, and b) Bird River sill: **in** Manitoba Mineral Resources Division, Report of Field Activities 1981, Report GS-16, p. 74-77.
1982: Mineral deposit investigations-Superior Province, I) Island Lake area, II) Bird River Sill (southeastern Manitoba); **in** Manitoba Mineral Resources Division, Report of Field Activities 1982, Report GS-9, p. 55-57.
1983: Geology of gold environments in the Bissett/Wallace Lake portion of the Rice Lake greenstone belt; **in** Manitoba Mineral Resources Division, Report on Field Activities, 1983, Report GS-17, p.101-107.
1984a: Mineral deposit investigations in the Rice Lake greenstone belt; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-23, p. 87-91.
1984b: Mineral deposit investigations: 1) gold occurrences in the Gods Lake area; and 2) platinum group metals in the Bird River Sill; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1984, Report GS-34, p. 129-132.
1985: Ultramafic rocks of the Island Lake area; Manitoba Energy and Mines, Geological Services, Geological Paper GP84-1, 29 p.

Theyer, P. and Gaba, R.G.
1986: Mineral deposit investigations in the Rice Lake greenstone belt; **in** Manitoba Energy and Mines, Minerals Division, Report of Field Activities 1986, Report GS-24, p. 120-124.
Thurber, G.R.
1911: Report of Moore claim; **in** Manitoba Energy and Mines, Mines Branch, Corporation File, Star Lake Gold Mines, Limited.
Turek, A., Weber, W. and Van Schmus, W.R.
1985: U-Pb zircon geochronology of the Rice Lake area; **in** Manitoba Energy and Mines, Geological Services Branch, Report of Field Activities 1985, Report GS-24, p.121.
Turek, A., Carson, T.M., Smith, P.A., Van Schmus, W.R., and Weber, W.
1986: U-Pb zircon ages for rocks from the Island Lake greenstone belt, Manitoba; **in** Canadian Journal of Earth Sciences, v. 23, p. 92-101.
Tuckwell, K.
1979: Stratigraphy and mineral deposits of the Sherridon area; **in** Manitoba Mineral Resources Division, Report of Field Activities 1979, Report GS-11, p. 42-45.
Walford, P.C. and Franklin, J.M.
1982: The Anderson Lake Mine, Snow Lake, Manitoba; **in** Precambrian Sulphide Deposits (R.W. Hutchinson, C.D. Spence and J.M. Franklin, eds.); Geological Association of Canada, Special Paper 25, p. 481-523.
Wanless, R.K., Stevens, R.D., Lachance, G.R., and Edmonds, C.M.
1968: Age determinations and geological studies K-Ar isotopic ages, Report 8; Geological Survey of Canada, Paper 67-2, 141 p.
Wanless, R.K., Stevens, R.D., Lachance, G.R., and Rimsaite, J.Y.H.
1966: Age determinations and geological studies: K-Ar isotopic ages, Report 6; Geological Survey of Canada, Paper 65-17, 101 p.
Weber, W.
1971: Geology of the Long Lake-Gem Lake area; **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D. McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, Report 3, p. 63-106.
Weber, W., Gilbert, H.P., Neale, K.L., and McGregor, C.R.
1982: Island Lake project (53/E 15); **in** Manitoba Mineral Resources Division, Report of Field Activities 1982, Report GS-7, p. 34-43.
Whiting, B.H. and Sinclair, A. J.
1986: New conclusions concerning the lithology and lithogeochemistry of the San Antonio gold mine, Bissett, Manitoba; **in** Gold'86, an International Symposium on the Geology of Gold Deposits, Toronto, Canada, September 28-October 1, Proceedings Volume, p. 171.
Williams, H.
1966: Geology and mineral deposits of the Chisel Lake map area, Manitoba; Geological Survey of Canada, Memoir 342, 38 p.
Wilson, H.D.B.
1972: The Superior Province in the Precambrian of Manitoba;**in** Geoscience studies in Manitoba (A.C. Turnock, ed.); Geological Association of Canada, Special Paper 9, p. 41-49.
Wilson, H.D.B., and Brisbin, W.C.
1961: Regional structure of the Thompson-Moak Lake nickel belt; **in** Canadian Institute of Mining and Metallurgy, Bulletin LXIV, p. 470-477.
1962: Tectonics of the Canadian Shield in northern Manitoba; **in** Royal Society of Canada, Special Publication, no. 4, p. 60-75.
Wright, J. F.
1923: Rice Lake Map-Area, southeastern Manitoba; **in** Geological Survey of Canada, Summary Report, 1922, Part C, p. 45.
1924: Geology and mineral prospects of the northern part of Beresford Lake map-area, southeast Manitoba; **in** Geological Survey of Canada, Summary Report, 1923, Part B, p. 86.
1928: Island Lake area, Manitoba; Geological Survey of Canada, Summary Report, 1927, Part B, p. 54-80.
1931: Geology and mineral deposits of part of northwest Manitoba; **in** Geological Survey of Canada, Summary Report, 1930, Part C, p. 1-124.
1932: Geology and gold prospects of the areas about Island, Gods, and Oxford Lakes, Manitoba; **in** The Canadian Mining and Metallurgical Bulletin, May, 1935, p. 155-162.
1938: Geology and mineral deposits of a part of southeastern Manitoba; Geological Survey of Canada, Memoir 169, 150 p.
1940: Gold mines and prospects in Rice Lake-Beresford Lake area, Manitoba; Canadian Institute of Mining and Metallurgy, Transactions, p. 613-626.
Zwanzig, H.V.
1971: Structural geology at Long Lake, Manitoba; **in** Geology and Geophysics of the Rice Lake Region, Southeastern Manitoba (W.D.McRitchie and W. Weber, eds.); Manitoba Mines Branch, Publication 71-1, p. 285-298.
1981: Granville Lake project; **in** Manitoba Mineral Resources Division, Report of Field Activities 1981, Report GS-5a, p. 17-21.
1983: Kisseynew project: Lobstick Narrows (parts 63K/13,14 and 63N/3,4); **in** Manitoba Mineral Resources Division, Report of Field Activities 1983, Report GS-4, p. 15-22.
1984: Kisseynew Project: Lobstick Narrows-Cleunion Lake, Puffy Lake and Nokomis Lake areas; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, Report GS-12, p. 38-45.
1985: Kisseynew Project; **in** Manitoba Energy and Mines, Report of Field Activities 1985, Report GS-12, p. 51-53.
Zwanzig, H.V., and Cameron, H.D.M.
1981: Granville Lake Project; **in** Manitoba Mineral Resources Division, Report of Field Activities 1981, Report GS-5, p. 17-21.
Zwanzig, H.V., Parker, J.S.D., Schledewitz, D.C.P., and Van Schmus, W.R.
1985: Lynn Lake regional compilation and geochronology; **in** Manitoba Energy and Mines, Geological Services, Report of Field Activities 1985, Report GS-1, p. 6-8.
Zwanzig, H.V., Thomas, M.W., and Keay, J.P.
1980: Laurie Lake; Manitoba Mineral Resources Division, Map GP80-1-3 (in Geological Paper GP80-1).

INDEX OF GOLD DEPOSITS AND OCCURRENCES

Deposit or Occurrence and Area

Page

Ace vein, Lynn Lake greenstone belt 61
Alberts Lake, Flin Flon-Snow Lake greenstone belt 47
Apex, Flin Flon-Snow Lake greenstone belt 56
Austin vein, Lynn Lake greenstone belt 61
Big Lynx, Oxford Lake greenstone belt 37
Bingo, Flin Flon-Snow Lake greenstone belt 52
Bounter, Flin Flon-Snow Lake greenstone belt 47
Caimito Group, Lynn Lake greenstone belt 61
Cartwright Lake (Bonanza claim group), Lynn Lake greenstone belt 70
Central Manitoba, Rice Lake greenstone belt 21
Century Mine, Flin Flon-Snow Lake greenstone belt 53
CL Group, Lynn Lake greenstone belt 61
Cowan, Island Lake greenstone belt 32
Cryderman (Little Pal), Rice Lake greenstone belt 27
Cyclone (Sask-Mani), Kisseynew gneiss belt 77
Diana (Gem Lake), Rice Lake greenstone belt 25
Dunbrack, Churchill-Superior boundary zone 42
Elora (Mill Vein), Rice Lake greenstone belt 28
Eva, Rice Lake greenstone belt 30
Evans Lake, Kisseynew gneiss belt 75
Farley Lake, Lynn Lake greenstone belt 67
Ferro-Rainbow, Flin Flon-Snow Lake greenstone belt 51
Gatlan, Rice Lake greenstone belt 18
Gemmell Lake, Lynn Lake greenstone belt 70
God's Lake Gold Mine, Gods Lake greenstone belt 37
Gold Group, Knee Lake greenstone belt 37
Gold Hill, Flin Flon-Snow Lake greenstone belt 53
Gold Pan and Gold Seal, Rice Lake greenstone belt 28
Grand Central (Lakeshore), Rice Lake greenstone belt 29
Gunnar, Rice Lake greenstone belt 21
Gurney Mine, Flin Flon-Snow Lake greenstone belt 51
High Rock Island (Ministik Lake Mine), Island Lake greenstone belt 35
Indian, Island Lake greenstone belt 32
Island Lake Mine, Island Lake greenstone belt 32
Jeep, Rice Lake greenstone belt 25
Johnson Shear, Lynn Lake greenstone belt 61
Johnston Knee Lake Mines Limited, Knee Lake greenstone belt 37
Jowsey Island, Gods Lake greenstone belt 37
Kitchener, Rice Lake greenstone belt 21
Kistigan Lake, Kistigan Lake 37
Knee Lake Gold Mines Limited, Knee Lake greenstone belt 37
Laguna Mine (Rex), Flin Flon-Snow Lake greenstone belt 50

Page

Lasthope, Lynn Lake greenstone belt 69
Lily Lake, Rice Lake greenstone belt 18
Lindal, Churchill-Superior boundary zone 42
LMD, Gods Lake greenstone belt 37
Lotus, Rice Lake greenstone belt 26
MacLellan Mine, Lynn Lake greenstone belt 61
Midas 54, Gods Lake greenstone belt 37
Moose Horn, Flin Flon-Snow Lake greenstone belt 52
Moss 1, Kisseynew gneiss belt 78
Neda, Island Lake greenstone belt 37
Nokomis Lake, Kisseynew gneiss belt 77
Nor-Acme Mine, Flin Flon-Snow Lake greenstone belt 47

Deposit or Occurrence and Area

O'Day, Cross Lake greenstone belt 41
Ogama-Rockland, Rice Lake greenstone belt 24
Okay Island, Island Lake greenstone belt 32
Onondaga, Rice Lake greenstone belt 28
Packsack, Rice Lake greenstone belt 29
Painkiller Bay, Knee Lake greenstone belt 37
Penniac Reef (Moore), West Hawk Lake-Falcon Lake-Shoal Lake area 14
Pickle No. 1 and No. 2, Oxford Lake greenstone belt 37
Poundmaker (Selkirk, Luleo), Rice Lake greenstone belt 26
Puffy Lake, Kisseynew gneiss belt 75
Ranger, Rice Lake greenstone belt 30
Reahil Island, Island Lake greenstone belt 32
San Antonio Mine, Rice Lake greenstone belt 18
Savage Island, Island Lake greenstone belt 32
Scott No. 1, Cross Lake greenstone belt 41
Smelter, Gods Lake greenstone belt 37
Snow Lake Mines (Goldfields), Flin Flon-Snow Lake greenstone belt 56
Solo-Oro Grande, Rice Lake greenstone belt 27
Squall Lake, Kisseynew gneiss belt 76
Sunbeam, West Hawk Lake-Falcon Lake-Shoal Lake area 9
Sundog, Island Lake greenstone belt 32
Tartan Lake, Flin Flon-Snow Lake greenstone belt 53
Thompson No. 2, West Hawk Lake-Falcon Lake-Shoal Lake area 13
T1A zone, Lynn Lake greenstone belt 69
Vanson, Rice Lake greenstone belt 17
Waverley, West Hawk Lake-Falcon Lake-Shoal Lake area 9
Wingold, Rice Lake greenstone belt 30
Wolf Prospect, Rice Lake greenstone belt 29

MAPS NOT

FILMED

CARTES

OMISES